Effects of data-based instruction for students with intensive early writing needs: A randomized control trial

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"You will keep in perfect peace those whose minds are steadfast, because they trust in you (Isaiah 26:3)"

Abstract

The purpose of this study was to examine the extent to which Data-Based Instruction (DBI) was effective in improving early writing performance of students with intensive needs depending on their special education status and types of writing skills. The extent to which DBI is feasible to implement was examined as a secondary purpose. A pretest-posttest control group design was used. Forty-eight students identified as at risk or with disabilities that affect their writing skills were assigned randomly within classrooms to either treatment or control conditions. Students in the treatment condition received DBI by six trained tutors three times per week, for 30 min per day, over 12 weeks. Students in the control condition received business as usual writing instruction in their classrooms. Students' writing performance was measured by Curriculum-Based Measures in Writing (CBM-W) and the Woodcock Johnson III Tests of Achievement (WJ III) writing subtests (Spelling, Writing Fluency, and Writing Samples) before and after the treatment. Tutors were asked to rate the feasibility, usefulness, and their overall satisfaction with DBI at the end of the study. Results of multivariate analyses of variance revealed a significant main effect of DBI for CBM-W. There was no significant main effect of DBI found for the WJ III writing subtests; however, a significant interaction between special education status and treatment condition was found, whereby students with disabilities in the treatment condition outperformed control students with disabilities. Tutors' positive ratings on the feasibility survey indicate the potential of DBI to be implemented in schools. Limitations followed by implications for research and practice are discussed.

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CHAPTER I

INTRODUCTION

The Individuals with Disabilities Education Act of 2004 (IDEA, 2004) allows states and school districts to use Responsiveness to Intervention (RTI) as an alternative way to identify students with learning disabilities. RTI is a multi-tiered framework with two purposes: (1) identifying students with learning disabilities and (2) providing early intervention to maximize all students' academic performance (Fuchs & Fuchs, 2007; Fuchs, Fuchs, & Vaughn, 2014). Within the RTI framework, students may be identified as having learning disabilities through systematic procedures designed to determine if they respond to scientific, research-based instruction across increasingly intensive tiers (Berkeley, Bender, Peaster, & Saunders, 2009; Fuchs & Fuchs, 2007; Fuchs et al., 2014). If students do not show adequate response to core instruction (Tier 1), they are moved to Tier 2 and possibly Tier 3 to receive more intensive intervention. The intensity of intervention is typically increased by providing interventions more frequently, over a longer time period, and/or in smaller numbers in homogeneous groups from specially trained instructors (Fuchs & Fuchs, 2007). Tier 3 is reserved for students who require the most intensive levels of intervention, both those considered as being at high risk of academic failure and possibly eligible for special education, and those already identified as having disabilities (Berkeley et al., 2009; Fuchs & Fuchs, 2007; Fuchs et al., 2014; Shapiro, n.d.).

Researchers and practitioners have put much effort into developing effective core instructional programs and supplemental small-group interventions (Chard et al., 2008).

As such, a wide array of instructional approaches have been developed and supported by research as being generally effective in improving students' academic performance within Tier 1 (core instruction) and Tier 2 (supplemental intervention). Yet, not every student responds sufficiently to these generally effective research-based approaches. In fact, approximately 3% to 5% of students from the general education population do not show sufficient progress in response to Tier 1 instruction or Tier 2 intervention, and require more intensive, individualized intervention in Tier 3 (Danielson & Rosenquist, 2014; Fuchs & Fuchs, 2007; Wanzek & Vaughn, 2009).

Empirical research examining the effects of tiered intervention shows that more intensive intervention can be effective for students who have shown insufficient response to interventions in Tiers 1 and 2. In recent studies, students who received more intensive intervention showed significantly improved outcomes compared to those who continued to receive general core instruction (Gilbert et al., 2013; Vaughn et al., 2010). However, for students who need the most intensive individualized intervention (Tier 3 intervention), intensifying the intervention by changing the delivery format and frequency of the small group intervention (Tier 2 intervention) may not be sufficient to enhance their performance (Gilbert et al., 2013). Beyond intensifying dosage (e.g., frequency and duration) of intervention, individualized intervention targeting the student's unique needs may be necessary to enhance students' performance (Fuchs et al., 2014; Parker, Dickey, Burns, & McMaster, 2012).

Researchers in special education have emphasized the use of ongoing formative assessment to monitor students' progress over time in order to individualize educational programs (Deno, 1990; Fuchs, Deno, & Mirkin, 1984; Fuchs & Fuchs, 1995; Fuchs, Fuchs, & Stcker, 2010). Formative assessment should (a) be sensitive to individual students' different responses, (b) be used to evaluate the current instruction based on continuous data, (c) involve teachers as primary instructional decision makers, and (d) be used to meet individual students' needs rather than group needs (Deno, 1990). In addition to using formative assessments, delivering individualized intervention designed based on information from formative assessments reflecting the unique learning needs of students is essential to promote their academic success (Fuchs & Fuchs, 1995; Stecker & Fuchs, 2000; Stecker, Fuchs, & Fuchs, 2005). One promising approach that incorporates formative assessments and individualized instruction to teach students who are identified as at risk or with disabilities is Data-Based Instruction (DBI; Fuchs et al., 2010).

In this dissertation, I propose the use of DBI to individualize instruction for children with the most intensive instructional needs. I focus on the area of beginning writing, an area that has been under-researched thus far (as described in more detail below). Specifically, I propose the use of research-based early writing intervention focusing on transcription skills (handwriting and spelling) in order to enhance writing performance of students identified at risk or having disabilities. I also propose the use of curriculum-based measurement in writing (CBM-W), which meets the four characteristics proposed by Deno (1990) above and has shown promising technical adequacy as a formative assessment tool for progress monitoring.

The Importance of Data-Based Instruction (DBI)

DBI, originally called Data-Based Program Modification (DBPM, Deno & Mirkin, 1977), is a systematic approach for using data to individualize instruction for students at risk or with disabilities. DBI is characterized by (a) a systematic process (not a single intervention program), (b) an ongoing cycle of implementation incorporating assessment and intervention rather than delivering one specific intervention, (c) intervention delivered in addition to, or instead of, Tier 1 and Tier 2 instruction, and (d) an implementation for a long period of time (Danielson & Rosenquist, 2014). This systematic repeated process prompts teachers to use formative assessments throughout their instruction, make instructional decisions on a regular basis, and change instruction in order to meet individual students' learning needs.

More specifically, by applying a series of DBI steps, teachers (1) assess students' current level of performance, (2) set a long-term goal, (3) implement research-based intervention with fidelity, (4) monitor students' progress toward the goal, (5) use data-based decision rules to evaluate students' responses and instructional effectiveness, (6) generate instructional hypotheses to identify appropriate interventions to meet individual students' needs, and (7) design and implement the individualized intervention based on the generated hypotheses (Deno & Mirkin, 1977; Fuchs & Fuchs, 2007; McMaster et al., 2014). The DBI steps are repeated to modify an individual student's intervention throughout the school year or until the intervention is no longer needed (Fuchs et al., 2014). Thus, DBI steps guide teachers to use data to determine when and how to individualize instruction (Danielson & Rosenquist, 2014).

Converging evidence shows positive effects of using DBI on teachers' instructional planning as well as students' academic outcomes (Stecker et al., 2005). Researchers have demonstrated that teachers who used DBI made instructional changes more frequently (Fuchs, Fuchs, & Hamlett, 1989a; Fuchs, Fuchs, Hamlett, Ferguson, 1992; Stecker & Fuchs, 2000) and identified appropriate targeted academic skills for individual students (Capizzi & Fuchs, 2005) than teachers who did not use DBI. Furthermore, in general, using DBI has resulted in accelerating rates of academic growth of students identified as at risk or with disabilities (Stecker et al., 2005). Thus, within a DBI framework, instructionally relevant data from formative assessments might help teachers design individualized intervention with information regarding specific areas of learning needs for individual students, leading to improve academic performance of students who are at risk of or who have disabilities (Fuchs, Fuchs, Hamlett, & Stecker, 1991; Fuchs et al., 1992; Parker et al., 2012; Stecker et al., 2005).

Research examining the promise of using DBI for improving students' performance has been conducted in reading (Capizzi & Fuchs, 2005; Fuchs et al., 1984; Fuchs, Fuchs, & Hamlett, 1989c; 1989d; Fuchs et al., 1992; Jones & Krouse, 1988; Wesson, 1991), mathematics (Fuchs, Fuchs, & Hamlett, 1989b; Fuchs, Fuchs, Hamlett, & Stecker, 1990; Fuchs et al., 1991; Stecker & Fuchs, 2000), and spelling (L. Fuchs, 1988; Fuchs et al., 1989a; Fuchs, Fuchs, Hamlett, & Allinder, 1991a, 1991b). To date, DBI research focusing on early writing skills has not been conducted, even though writing skills are important for school and vocational success (Graham & Perin, 2007). Thus, extensions of DBI research should include a focus on early writing skills.

The Importance of Writing and Early Writing Intervention

Proficient writing is important in school because most academic subjects require students to synthesize information or knowledge through written work. Postsecondary education and the workplace also call for written responses or products; for example, to evaluate the qualifications of applicants (Graham, 2008). Even though writing is important, it does not arouse much attention in educational research (Berninger et al., 2006; Berninger et al., 2000; Graham & Harris, 2002; McMaster, Ritchey, & Lembke, 2011). Further, teaching and practice of writing is the least emphasized among the three fundamental academic areas (reading, writing, and arithmetic) in schools and classrooms (National Commission on Writing, 2003).

In spite of the importance of writing skills, a large number of students with and without disabilities have not achieved proficient levels in writing. Based on recent reports from the National Assessment of Educational Progress (NAEP, 2011), a large number of students (74% of 8^{th-}graders and 73% of 12^{th-}graders) have not showed proficient levels in writing. The gap for each grade has decreased since a report from NAEP in 2007, by 14% and 9% respectively, but a large proportion of students still have failed to achieve proficient levels. These results highlight the need to develop and implement effective research-based writing interventions for those who are below proficient levels.

Students' writing problems are often not detected until intermediate grades when school curriculum requires more comprehensive writing skills of students (Berninger et al., 2006; Berninger et al., 2002). Yet, it is important to identify students struggling in writing and provide effective research-based intervention in early elementary grades, to prevent students from experiencing long-term academic failure in writing. According to an early literacy longitudinal study by Juel (1988), students identified as poor readers and writers in first grade showed high probabilities of remaining poor readers and writers at the end of fourth grade. The negative consequences of allowing early literacy problems to persist without intervention highlight the importance of early writing intervention. To address these concerns, researchers have developed and examined the effects of various early writing interventions. Research has shown that students who received research-based early writing intervention have improved significantly in overall writing performance beyond specific writing sub-skills that they were taught (Graham, Harris, & Chorzempa, 2002; Graham, Harris, & Fink, 2000).

The positive empirical findings support a theoretical model of writing for young students called the *simple view of writing* (Berninger, 2000; Berninger & Amtmann, 2003). The *simple view of writing* specifies components of writing and the interactions among these components. The components of writing include transcription (handwriting and spelling), text generation, and executive functioning (Berninger, Fuller, & Whitaker, 1996, Berninger & Winn, 2006). Among the components, transcription has been shown to play a critical role in writing and writing development, particularly for beginning writers (Graham & Harris, 2000). Mastery of transcription is important because the processing involved in lower-level writing skills such as handwriting and spelling requires substantial cognitive resources. If students have to devote considerable attention to accurate letter formation and spelling words while writing, it limits cognitive resources needed for writing text (McCutchen, 2006). Thus, a lack of proficiency in transcription skills interferes with higher-level writing processes such as planning and content generating, resulting in low quantity and quality of writing text (Graham, 1990; Scardamalia, Bereiter, & Goleman, 1982).

Based on the *simple view of writing*, as lower-level writing skills (transcription) become automatic, more cognitive resources are available for higher-level writing skills and/or other cognitive processes (text generation and executive functioning). Thus, improving transcription skills should free up cognitive resources necessary to devote to text generation, which should lead to improved overall writing proficiency. Accumulated empirical evidence has supported the benefits of writing intervention designed to focus on transcription skills—specifically, handwriting and spelling—for improving overall writing proficiency for students with and without disabilities as well as for those who are at risk in writing (Berninger et al., 2006; Berninger et al., 1997; Berninger et al., 2002; Berninger et al., 1998; Graham et al., 2002; Graham et al., 2000; Jones & Christensen, 1999). In this dissertation, early writing intervention mainly consisted of handwriting and spelling activities, designed to improve automatic letter formation and/or spelling of words. Initially, the early writing intervention was delivered as a standardized protocol by delivering it to every student in the same, and eventually it became individualized based on students' needs.

The Importance of Curriculum-Based Measurement (CBM)

Within a DBI framework, in addition to implementing research-based intervention, monitoring students' progress using a systematic formative assessment tool is essential to determine if the intervention is effective for the students, and eventually for improving students' academic performance. Given that students eligible for DBI are those who need the most intensive individualized intervention, frequent progress monitoring is needed to examine their responsiveness to the intervention (Fuchs & Fuchs, 2007). Instructional decisions about students' responsiveness to intervention should be based on formative assessment data, rather than relying on teachers' subjective judgment (Fuchs et al., 1984). One promising formative assessment tool to help teachers' instructional decisions is curriculum-based measurement (CBM).

CBM consists of a set of brief tasks to measure students' academic progress frequently using multiple probes with equivalent difficulty (Deno, 1985, 1990, 2003; McMaster & Espin, 2007). Deno and colleagues from the Institute for Research on Learning Disabilities (IRLD) at the University of Minnesota developed CBM for special education teachers to help them evaluate the effectiveness of their intervention and make instructional decisions (Stecker et al., 2005). To achieve this goal, the researchers identified key indicators of academic performance, and developed a simple and efficient set of measures in reading, mathematics, spelling, and written expression (Deno, 1985).

Several unique characteristics of CBM make it fit well for use as a progress monitoring tool within a DBI framework. First, unlike other types of measures, CBM is considered to be a General Outcome Measurement (GOM, Fuchs & Deno, 1991). It measures essential outcomes that students are expected to achieve at the end of year rather than mastery of a series of sub-skills. Thus, CBM scores represent an index of a student's overall proficiency in academic areas. Second, CBM has been demonstrated to have sufficient technical features. Findings from comprehensive reviews conducted by

Deno and colleagues have supported CBM as providing reliable and valid estimates of students' performance in mathematics, writing, and reading (see Foegen, Jiban, & Deno, 2007; McMaster & Espin, 2007; Wayman, Wallace, Wiley, Ticha, & Espin, 2007 for reviews). Third, CBM is characterized by standardized administration and scoring procedures, multiple parallel forms that are comparable in difficulty level, time efficiency, and graphical representation of student performance for instructional decision making (Deno, 2003, Stecker et al., 2005). With the above characteristics of CBM, teachers are able to measure students' academic progress over time repeatedly. Specifically, teachers are able to evaluate the effectiveness of their intervention as CBM depicts students' scores on graphs and shows their performance as measurable and observable indicators (Stecker et al., 2005), which is well aligned with DBI.

Beyond the unique characteristics of CBM, previous research has established the utility of CBM for progress monitoring at three stages (L. Fuchs, 2004). Studies at the first stage examine technical features of static scores measured by CBM in terms of reliability and validity (Stage 1). Studies at the second stage examine technical features of slopes by CBM in terms of sensitivity to growth in the certain academic tasks (Stage 2). Studies at the third stage examine the instructional utility of CBM scores for making instructional decisions (Stage 3). Research on CBM in writing (CBM-W) for beginning writers in grades 1 to 3 can be delineated according to these three stages (see McMaster, Ritchey, et al., 2011 for a review).

Stage 1 research on CBM-W for beginning writers has been conducted using static scores measured by a wide range of writing tasks and scoring procedures

(McMaster, Ritchey, et al., 2011). Reliability and validity coefficients of CBM-W were examined at different levels of writing tasks (letter-, word-, sentence-, and discourse-levels) for various scoring procedures, which reflect different aspects of writing skills such as productivity (the amount of writing within a limited time period), accuracy (amount or percent of writing that is accurate in terms of spelling and grammar), or quality of writing (overall impressions using holistic ratings; Ritchey & Coker, 2013). In general, researchers have found promising reliability and validity evidence, indicating that static scores measured by CBM-W can be used as an overall indicator of students' writing performance (McMaster & Espin, 2007). Stage 2 research has been conducted for examining the sensitivity to growth in writing or exploring reliability and stability of slopes of CBM-W (Coker & Richey, 2010; McMaster, Du, et al., 2011; Parker, McMaster, Medhanie, & Silberglitt, 2011). Research has shown preliminary evidence of technical features of slopes as sensitive to students' writing growth (McMaster, Ritchey, et al., 2011). Stage 3 research has been conducted for examining the instructional utility of CBM in spelling within a DBI framework in late 1980s and early 1990s (L. Fuchs, 1988; Fuchs et al., 1989a; Fuchs et al., 1991a, 1991b). Students who received DBI, a system incorporating ongoing progress monitoring and instructional decision making based on data measured by CBM, showed significant higher spelling performance than those in control condition.

Converging evidence has supported the technical adequacy of CBM-W for beginning writers in terms of reliability, validity, and sensitivity to growth. Relatively few randomized control trials, have been conducted to evaluate the benefits of instructional utility of CBM-W within a DBI framework. Thus far, there is no Stage 3 study associated with examining the effects of instructional utility of CBM-W, in early writing intervention. Thus, an important next step is to examine the effects of instructional utility of CBM-W focusing on early writing skills. In this dissertation, I use a DBI framework to examine the instructional utility of CBM-W used to monitor the effects of evidence-based early writing intervention and further individualize intervention for struggling writers.

Purpose of the Study and Research Questions

The purpose of this study is to examine the differential effects of Data-Based Instruction (DBI) on the beginning writing performance of children identified as at risk or with disabilities that affect their writing skills depending on their special education status and type of writing skills. As illustrated above, DBI is designed for students in need of the most intensive, individualized interventions, including students at risk but not yet identified for special education services as well as those already receiving special education services. To determine whether DBI is more or less effective for these two groups, differential effects of DBI will be examined by students' special education status. Furthermore, given theoretical and empirical support for interventions that emphasize transcription skills to improve overall writing proficiency, the differential effects of DBI on different types of writing skills (as measured by CBM-W and standardized measures of writing) will be examined. Given that this is the first examination of DBI in early writing, the feasibility of DBI will be explored as a secondary purpose of the study. Specific research questions include the following:

(1) What are the effects of DBI on writing outcomes of students in Grades 1 to 3 at risk or identified with disabilities? Do the effects of DBI vary by (a) special education status and (b) type of writing skills as measured by CBM-W and a standardized writing measure?

(2) To what extent is DBI feasible to implement with beginning writers?

I hypothesized that students who received early writing intervention along with the DBI process would outperform control students in their writing achievement. I did not have a specific hypothesis regarding whether the effects of DBI would vary by special education status and type of writing skills.

CHAPTER II

LITERATURE REVIEW

The purpose of this review is to explore the evidence of how data-based instruction (DBI) can be used to improve performance of students who are at risk of academic failure or who have academic-related disabilities, and to obtain direction from the literature regarding the components that must be in place for DBI to be successful in the area of early writing. Given that DBI requires the integration of intervention and assessment, I reviewed literature to identify intervention and assessment practices that show promise for use with children who struggle with early writing skills. Thus, in this chapter, I review three relevant areas of research: (1) research examining the effects of using DBI to improve students' performance in basic academic areas; (2) evidence of the effects of research-based early writing intervention in improving students' text generation skills; and (3) technical characteristics of Curriculum-Based Measures in writing (CBM-W) for beginning writers.

Effects of Data-Based Instruction (DBI)

DBI has a long history in special education research, with most of the focus on reading and mathematics. Stecker et al. (2005) conducted the most recent review examining the effects of DBI for enhancing the academic achievement of students with mild to moderate disabilities, and additional literature searches yielded a few more studies (Capizzi & Fuchs, 2005; L. Fuchs, 1988; Fuchs et al., 1989a; Fuchs et al., 1991a, 1991b). Converging evidence shows the positive effects of using DBI on teachers' instructional planning as well as students' academic outcomes. Teachers who used DBI made instructional changes more frequently (Fuchs et al., 1989a; Fuchs et al., 1992; Stecker & Fuchs, 2000) and identified more appropriate targeted academic skills for individual students (Capizzi & Fuchs, 2005) than did teachers who did not use DBI. Furthermore, in general, using DBI resulted in accelerating rates of academic growth of students with mild to moderate disabilities (Stecker et al., 2005). Most DBI studies have been conducted in reading and mathematics. Several studies, however, have also supported the benefits of using DBI for improving students' spelling performance (L. Fuchs, 1988; Fuchs et al., 1989a; Fuchs et al., 1991a, 1991b).

All of the studies in the Stecker et al. (2005) review included the use of CBM to monitor students' progress and make data-based instructional decisions. Frequent administration of CBM for progress monitoring alone, however, has not appeared to be sufficient to enhance students' academic performance within a DBI framework. Critical variables that appeared to affect students' performance were (1) using standardized data-based decision rules with accuracy, (2) providing specific instructional feedback to teachers using skills analysis, and (3) providing instructional recommendations and advice to teachers for instructional changes via different forms of consultation (Allinder, 1996; Stecker et al., 2005).

Using Data-Based Decision Rules with Accuracy

Within a DBI framework, teachers examine the trend of students' progress depicted on a graph and make instructional decisions by applying data-based decision rules. After collecting a pre-determined number of data points (e.g., 4 to 10 data points; Fuchs et al., 1984; Fuchs et al., 1992; Stecker & Fuchs, 2000), teachers apply a set of data-based decision rules and make instructional decisions by examining a trend line in relation to a goal line. The goal line represents a desired slope of improvement from the baseline (current level of performance) to a long-term goal. The trend line is usually calculated using an ordinary least squares (OLS) regression, representing a trend of the student's performance measured by on a frequent basis. If the trend line is *steeper* than the goal line, the decision would be to raise the long-term goal by incorporating the individual student's current rate of growth. If the trend line is *less steep* than the goal line, the decision would be to change the instruction. If the trend line is *as steep as* the goal line, the decision would to continue the current intervention as is (Deno & Mirkin, 1977; Fuchs & Fuchs, 2007; McMaster et al., 2014). Teachers add a vertical line on the graph when they make instructional decisions either raising the long-term goal or making an instructional change, collect additional data, and apply the data-based decision rules again. Thus, monitoring students' academic progress and making instructional decision based on collected data is a repeated process within DBI.

Two studies examined the differential effects of two decision options within the data-based decision rules (goal-raising and instructional changes) and emphasized their significance for enhancing students' academic performance (Fuchs et al., 1989b; Stecker & Fuchs, 2000). In a study focusing on DBI in mathematics, students whose special education teachers were directed to raise the long-term goal when the trend line was steeper than the goal line outperformed those whose teachers were not directed to raise the goal (Fuchs et al., 1989b). In another study by Stecker and Fuchs (2000), special education teachers were requested to make instructional changes for their students using individual progress monitoring data and deliver the same intervention to their matched pairs who had shown comparable levels of academic performance in mathematics. Results showed that students who received individualized instruction based on their own progress monitoring data performed significantly better than did their matched pairs on a standardized mathematics achievement test. These findings indicate the importance of data-based decision rules for directing teachers to make individualized instructional decisions, leading to students' academic improvement.

In addition to using standardized data-based decision rules, accurate implementation of the rules at appropriate timings is critical to affect students' performance (Stecker & Fuchs, 2000). If teachers retained inappropriate long-term goals or interventions that did not currently work for the individual students, students might not benefit from the intervention and lose opportunities to accelerate their rate of academic growth. Findings from a study conducted by Allinder (1996) indicated the importance of the degrees of adherence to the data-based decision rules for enhancing students' performance. Teachers with high accuracy of implementing the data-based decision rules measured students' progress more frequently, set more ambitious goals, and changed instruction appropriately, resulting in improving students' performance (Allinder, 1996).

Specific Skills-Analysis Feedback

Within a DBI framework, graphic analysis and data-based decision rules are necessary for teachers to make timely and appropriate instructional decisions, but not sufficient to improve students' academic performance. Teachers often need further qualitative information about target areas in which the students need to improve to make individually appropriate instructional changes (Fuchs et al., 1990). To address this need, Fuchs and colleagues developed skills-analysis using computerized applications. The skills-analysis provided instructionally useful information in a systematic way by analyzing students’ response to CBM tasks by types of sub-skills and categorizing the specific responses or items by degrees of mastery for each sub-skill (Fuchs et al., 1989a; Fuchs et al., 1990; Stecker & Fuchs, 2000).

Previous research has shown positive effects of using skills-analysis beyond graph analysis for enhancing students’ performance in spelling and mathematics (Fuchs et al., 1989a; Fuchs et al., 1990). Teachers who used the skills-analysis program received additional qualitative information along with students’ performance depicted on a graph, which also was given to teachers who used graph analysis only. The qualitative information included type of sub-skills with accuracy rates and students’ actual responses or items for each sub-skill. For mathematics, the degrees of mastery or accuracy for each sub-skill were summarized in a graphical grid (Fuchs et al., 1990). For spelling, the three most frequent types of spelling errors were identified (Fuchs et al., 1989a). Teachers’ use of the skills-analysis program led to positive effects on teachers’ instructional changes and students’ academic performance. Teachers who used the skills-analysis program along with graph analysis made more specific instructional changes by incorporating specific target skills than did those who used graph analysis alone (Fuchs et al., 1989a; Fuchs et al., 1990). The findings imply that qualitative information specifying target skills help teachers to design more effective instructional plans, resulting in improved student performance.

Instructional Recommendations

Accessibility to instructional materials and instructional recommendations are also important for designing effective individualized intervention (Stecker et al., 2005). In previous DBI research, researchers incorporated various forms of consultation into the DBI framework in order to provide instructional support for teachers and resolve their difficulties using graphed information for changing instruction and making instructional plans that reflect those changes (Tindal, Fuchs, Christenson, Mirkin, & Deno, 1981). Trained consultants provided instructional recommendations including specific strategies and skills relevant to individual students to teachers and provided instructional materials upon request. The types of consultation used in DBI literature can be categorized in four groups: individual follow-up consultation, peer collaboration, self-monitoring, and computerized expert program. Below, I review findings of studies which examined the effects of consultation on students' academic performance by each type of consultation.

Individual follow-up consultation. For individual follow-up consultation, trained university staff met individual teachers who were implementing DBI, and provided instructional feedback and supports regularly after an initial training workshop (Allinder & BeckBest, 1995; Wesson, 1991). The university staff suggested instructional strategies for improving students' performance and provided instructional materials if teachers requested them. The effects of individual follow-up consultation were evaluated compared to other forms of consultations including peer collaboration and self-monitoring, as described in more detail below.

Peer collaboration. For peer collaboration, a small group of teachers gathered regularly after an initial training workshop, shared issues that arose while they implemented the intervention, and brainstormed to resolve the problems. In a study by Wesson (1991), 55 special education teachers received either individual follow-up consultation or peer-collaboration. No significant differences were found between the two consultation formats on students' performance in reading. The author suggested that the small group format may be preferable to schools due to its cost effective features (Wesson, 1991).

Self-monitoring. Self-monitoring is designed for teachers to monitor their implementation of DBI through self-monitoring checklists (Allinder & BeckBest, 1995; Allinder, Bolling, Oats, & Gagnon, 2000). Allinder and BeckBest (1995) compared the effects of individual follow-up consultation with self-monitoring. After the initial training workshop for implementing DBI, special education teachers received individual follow-up consultation from university staff, or they were asked to complete self-monitoring checklists whenever they made instructional changes applying the data-based decision rules. The self-monitoring checklists contain a series of procedural questions related to implementation of the DBI and open-ended questions regarding description of students' progress and instructional plans. The self-monitoring condition showed comparable effects to individual follow-up consultations from university staff on students' performance in mathematics (Allinder & BeckBest, 1995). In another study by Allinder et al. (2000), significant positive effects of self-monitoring were found compared to the effects of using graphed analysis only. In general, teachers who used self-monitoring checklists changed their instruction more often and designed their instruction incorporating specific instructional strategies and target skills.

Computerized expert program. Computerized expert program refers to a computerized systematic program that provides instructional recommendations and advice based on synthesized information from a variety of resources (Fuchs et al., 1991a, 1991b; Fuchs et al., 1992). The computerized expert program requests teachers to enter information about students' performance drawn from results measured by CBM, teachers' judgment on students' performance in schools, and feasibility to implement the intervention. Based on the information, the expert program generates recommendations on the nature of instructional changes in terms of target areas to focus on, specific strategies along with detailed implementation procedures and materials, and motivational strategies. Converging evidence has supported the benefits of using the computerized expert program to enhance students' performance in reading, mathematics, and spelling (Fuchs et al., 1991a, 1991b; Fuchs et al., 1992). In terms of teachers' adjustments in their instructional programs, no significant differences were found on quantitative aspects of changes including the number of goal changes, level of goal ambitiousness, and the number of instructional changes. Significant differences were found on the nature of instructional changes. Teachers who used the computerized expert program designed more diverse instructional programs or incorporated more structured activities and strategies into their intervention than teachers in the control condition.

Summary

In sum, findings from the DBI literature reviewed above have supported the positive effects of DBI for improving students' academic performance in reading, mathematics, and spelling (Capizzi & Fuchs, 2005; L. Fuchs, 1988; Fuchs et al., 1989a, 1989b, 1989c, 1989d; Fuchs et al., 1991a, 1991b; Stecker et al., 2005). Whereas no studies were specifically conducted in writing, these positive findings suggest that DBI may also hold promise in other academic areas, and thus research in early writing is warranted. Based on the existing literature, three components effecting improved students' performance were identified: (a) applying standardized data-based decision rules with accuracy, (b) providing skills-analysis feedback, and (c) providing instructional recommendations through consultation. Thus, to maximize the effects of DBI in early writing, these three components were incorporated into this dissertation study.

Effects of Research-Based Early Writing Intervention

Implementing research-based intervention with fidelity is an essential component within a DBI framework (Fuchs & Fuchs, 2007). Fidelity of implementation refers to the degree to which an intervention is implemented as intended. It is important to implement a research-based intervention with fidelity because it helps teachers determine the effectiveness of intervention and make instructional decisions (Mellard, 2010). If the fidelity of implementation was not adequate, a student's low performance to the intervention cannot be attributed either due to the effectiveness of the intervention or their need for intensified intervention. Given that the fidelity of implementation influences the effectiveness of the intervention and ultimately student outcomes, researchers suggest implementing research-based interventions with fidelity before making changes to the intervention (O'Donnell, 2008; Pierangelo & Giuliani, 2008).

Research-based writing interventions do exist for beginning writers, and most of these interventions focus on transcription skills. This focus aligns well with the *Simple View of Writing* (Berninger, 2000; Berninger & Amtmann, 2003), which suggests that improving students' transcription skills will free up cognitive resources needed to devote to text generation. The hypothetical claim in the *Simple View of Writing* that successful text generation depends on mastery of transcription skills, is supported by correlational studies (Graham, Berninger, Abbott, Abbott, & Whitaker, 1997; Juel, 1988; Jones & Christensen, 1999; Puranik & AlOtaiba, 2012), and the claim is strengthened by accumulated evidence from experimental intervention studies (Thompson, Diamond, McWillian, Snyder, & Snyder, 2005; Graham et al., 2000). Below, I review literature that has examined the effects of explicit handwriting and spelling intervention in improving text generation skills in terms of quantity and quality. Then, I identify effective features that have further enhanced text generation skills.

Effects of Transcription Intervention on Text Generation

Several experimental intervention studies provide evidence that explicit handwriting and spelling intervention can improve students' text generation skills (Amtmann, Abbott, & Berninger, 2008; Berninger, Abbott, Whitaker, Sylvester, & Nolen, 1995; Berninger et al., 1997; Berninger et al., 1998; Berninger et al., 2000; Berninger et al., 2002; Berninger et al., 2006; Graham et al., 2002; Graham et al., 2000;

Jones & Christensen, 1999). Students who received explicit handwriting and/or spelling intervention have showed significant improvement in each transcription skill. The effects of intervention focusing on transcription skills have transferred to text generation quantity, whereas effects on text generation quality have been mixed.

Handwriting intervention. Berninger and colleagues found positive effects of explicit handwriting intervention on handwriting skills as well as text generation quantity. Berninger et al. (1997) examined the effects of explicit handwriting intervention involving multisensory strategies beyond the effects of phonological awareness training. The multisensory strategies were designed to stimulate sensory organs to learn alphabet letters, and they included motor imitation, visual cues, memory retrieval, combined visual cues and memory retrieval, and copying. Students who received the explicit handwriting interventions incorporating multi-sensory strategies outperformed those who received phonological training on automatic letter formation and fluent writing. Among the five alternative treatments, the combined instructional intervention (visual cues + memory retrieval) appeared to be the most effective method. In another study, Berninger and colleagues (2006) found differential effects of neurodevelopmental training beyond explicit handwriting instruction for first-grade students with handwriting difficulties. Students who received combined neurodevelopmental training and explicit handwriting intervention showed more gains in accurate and legible letter formations. Students who received only handwriting showed more gains in automatic letter formations and text generation quantity.

Jones and Christensen (1999) found benefits of explicit handwriting intervention beyond a regular supplemental writing program for students with handwriting difficulties. The treatment students showed significantly lower performance in text generation quantity and quality before the intervention, but after the intervention, they performed at levels similar to their typically developing peers. Graham et al. (2000) found inconsistent results regarding the effects of handwriting intervention on text generation quality. Students who received a series of explicit handwriting activities made great improvements in text generation quantity compared to those who received phonological awareness training when they were assessed immediately after the intervention (d = 0.76), as well as six months later (d = 0.70). There was no significant improvement in text generation quality.

Spelling intervention. Berninger and colleagues also conducted several spelling studies using multilayered spelling instruction by incorporating alternative approaches for teaching how to spell words, connections between spoken and written words, for students identified as poor spellers. The multilayered spelling instruction comprised different levels of writing activities at letter, word, and discourse levels. Among the different levels of writing, explicit spelling intervention was associated with the word level activities. Researchers tested the effects of alternative approaches to the spelling intervention.

Berninger et al. (1998) used various unit sizes of alphabet letters alone or in combinations for teaching connections between sounds and letters. A multilayered explicit spelling intervention was more effective than phonological and orthographic awareness training on spelling and text generation, as well as on the rate of growth in spelling performance. No differential effects were found among alternative approaches on trained words. Combined instruction of whole word and onset-rime (WW-OR) condition, however, was the most effective in transferring the alphabetic principle training to untrained words. Students in whole word, phoneme-letter, and onset-rime (WW-PL-OR) condition showed significantly greater gains in text generation quantity compared to others.

Berninger et al. (2000) incorporated explicit syllable awareness training to spelling instruction within the multilayered framework. Participating students were taught either the alphabetic principle only or combined alphabetic principle and syllable awareness training with polysyllabic words. The combined alphabetic principle and syllable awareness treatment was more effective than alphabet principle only treatment for spelling and text generation quantity. More specifically, the combined treatment was effective on spelling words on which students were not trained and for silent e/long vowel syllables in taught words.

In another study, Berninger et al. (2002) compared three different writing interventions – spelling, composition, and combined spelling and composition -- to a control condition. Each treatment condition consisted of explicit alphabetic principle instruction for spelling or teacher-directed scaffolding instruction for writing, alone or in combination. The control condition involved keyboarding and writing practices without explicit instruction. Significant improvement was found in text generation quantity for all students in the three treatment conditions. Significant improvement of text generation quality was found only for students who received combined spelling and composition intervention. Similarly, Graham et al. (2002) examined the effects of explicit spelling intervention designed to develop knowledge of spelling systems against mathematics intervention. Students in the treatment condition showed significant improvement in spelling and text generation quantity immediately following intervention (d = 0.70 and 0.78 respectively) but did not in text generation quality. The effects of explicit spelling intervention were maintained on spelling but not on text generation quantity, after six months the intervention ended.

Effective Features of Transcription Intervention

From the available studies, several effective features of transcription interventions have emerged. These are summarized below and in Table 1. First, previous research has shown that facilitating cognitive processes related to memory is a promising feature of transcription interventions (Berninger et al., 1997; Berninger et al., 1998; Berninger et al., 2000; Berninger et al., 2006; Graham et al., 2002; Graham et al, 2000). The cognitive processes involved in handwriting and spelling include representing letters or words in memory *and* retrieving letters or words from memory. Handwriting skills do not only require motor processing and spelling skills do not only require memorizing a sequence of letters (Berninger et al., 1997; Berninger et al. 2002). Rather, both transcription skills involve cognitive operating processes in memory that enable letter representation and letter retrieval.

For handwriting intervention, visual cues or visual association strategies were used to prompt students to form letters accurately and efficiently in memory. Letters with numbered arrows indicating the nature, order, and direction of strokes served as a visual cue (Berninger et al., 2006; Berninger et al., 1997; Graham et al., 2000), and visual association strategies included visual symbols which represent alphabet letters (e.g., *w* is like a worm, Jones & Christensen, 1999). Several prompts including asking students to write without looking at the letters were embedded in the activities to stimulate students' retrieval of letters from memory. Students were asked to write letters from memory after seeing target letters on cards while teachers covered the target letters (Berninger et al., 2006; Berninger et al., 1997), or they were asked to complete missing letters in alphabetical order by increasing the number of missing letters over time (Jones & Christensen, 1999),

For spelling, in order to facilitate the process of representing spelling of words in memory and retrieving the spellings from memory, Berninger and colleagues (1998, 2000) asked students to "think about how the word sounds in your mind's ear and looks in your mind's eye" (Berninger et al., 1998, p. 593) and spell the words out loud. The spelling intervention in Graham et al. (2002) also incorporated the similar approach of using the mind's ear and eye. During a series of explicit spelling activities, students were asked to say the target word and letters in the word, close their eyes to say the letters, and write the word and letters several times.

Second, letter-sound or letter-name correspondence activities before or during the transcription activities have appeared to be effective (Berninger et al., 1997; Berninger et al., 1998; Berninger et al., 2000; Berninger et al., 2002; Graham et al., 2002 Graham et al., 2000). In handwriting intervention studies, students listened to the names of target letters while they wrote or traced letters during handwriting intervention, or they were taught the name of each letter through a variety of letter-sound correspondence activities before handwriting activity. Naming letters can serve as a verbal cue to connect to appropriate letters and help students remember ways to form the letters (Berninger et al., 1997).

In spelling intervention studies, researchers included alphabetic principle or phonics training before or during spelling activities (Berninger et al., 1998; Berninger et al., 2000; Berninger et al., 2002; Graham et al. 2002). Alphabetic principle training started with identifying and naming phonemes orally and naming letters or spelling units in words. As spelling requires translating phonemes to written letters, naming the target phonemes would provoke phonological awareness so that it facilitates the spelling process and the translation of spoken words to written words (Berninger et al., 2002). Thus, alphabetic principle or phonics training appears to help students learn to match between sounds and spelling units.

Third, repeated practice, such as copying or tracing letter activities for automatic letter formations and using multi-sensory approaches for spelling words have appeared to be effective in transcription interventions (Berninger et al., 2006; Berninger et al., 1997; Berninger et al., 1998; Berninger et al., 2000; Berninger et al., 2002; Graham et al., 2000). In handwriting intervention studies, students were asked to look carefully at a target letter and copy what they saw without any cues, or to trace the target letter multiple times through scaffolded instruction. For scaffolded instruction, students practiced writing letters with numbered arrows, without numbered arrows, within an outline of the letter, and then on regular lined paper. Copying (one of the alternative handwriting interventions in the study by Berninger et al., 1997), was not the most effective, suggesting that practice of letter formation using one-time copying is not sufficient for enhancing accuracy of letter formations. Repeated practice of copying, however, could be used to enhance automatic letter formations.

In spelling intervention studies, students were exposed multiple times to connecting words and letters in the words using their ear, eye, hand, and mouth to acquire spelling of words (Berninger et al., 1998; Berninger et al., 2000; Berninger et al., 2002). Students were shown words (eye), given pronunciations of the words (ear), and asked to say the words and name the letters (mouth) for various units of letters in alone and combination.

Table 1

Effective Features of Transcription Intervention

Effective Features	Type of Transcription	Sub-Features	Writing Activities	Studies
Facilitating cognitive process related to memory	Handwriting	Representing letters or words in memory	Using visual cues: Tracing and writing letters with numbered arrows	Berninger et al., 2006; Berninger et al., 1997; Graham et al., 2000
			Using visual association strategies while provide verbal prompts (e.g., *w* is like a worm)	Jones & Christensen, 1999
		Retrieving letters or words from memory	Writing letters from memory after seeing target letters on cards while teachers covered the letters	Berninger et al., 2006; Berninger et al., 1997
			Completing missing letters in alphabet order	Jones & Christensen, 1999
	Spelling	Representing letters or words in memory	Asking students to think about word sounds in mind's ear and looking the words in mind's eye	Berninger et al., 1998; Berninger et al., 2000
			After saying the target words and letters, closing eyes and saying the letters again	Graham et al., 2002
		Retrieving letters or words from memory	Spelling the words aloud from memory	Berninger et al., 1998; Berninger et al., 2000
			Writing the words from memory	Graham et al., 2002
Adding letter-sound/name activities	Handwriting	Letter-sound/name correspondence	Listening to the names of target letters while writing or tracing letters	Graham et al., 2000
			Matching names and sounds of alphabetic letters	Berninger et al., 1997
	Spelling	Alphabetic principle or phonics training	Identifying and naming phonemes/letters/spelling units orally	Berninger et al., 1998; Berninger et al., 2000; Berninger et al., 2002; Graham et al., 2002
Repeated practice	Handwriting	Copying	After looking at the target letter, copying what they see	Berninger et al., 1997; Berninger et al., 2006
		Tracing	Tracing the same letters multiple times	Graham et al., 2000
	Spelling	Multi-sensory approach	Exposing multiple times to connecting words and letters in the words using their mind's ear, eye, hand, and mouth	Berninger et al., 1998; Berninger et al., 2000; Berninger et al., 2002

Summary

In sum, the early writing intervention literature reviewed above indicates that explicit handwriting and spelling intervention can enhance students' text generation skills, in addition to handwriting and/or spelling skills for students in early elementary grades struggling with transcription skills targeted for the intervention. The findings highlight the need for early writing intervention to focus on transcription skills (handwriting and spelling) to improve higher-level writing skills (overall writing proficiency). To enhance the effects of early writing intervention within DBI, I identified three features and incorporated them into the intervention component of this dissertation. Specifically, for handwriting and spelling activities, students should (a) be involved in representing letters or words in memory and retrieving letters or words from memory, (b) receive letter-sound or letter-name activities, and (c) have opportunities for repeated practices. In addition, it is important to implement the interventions with fidelity.

Curriculum-Based Measurement in Writing (CBM-W)

In addition to effective interventions, selecting appropriate and effective progress monitoring tools is critical for ongoing decision making within a DBI framework. To be tenable for measuring students' progress over time, measurement tools must include multiple probes of equivalent difficulty and provide scores representing the academic performance that the student is expected to accomplish at the end of year (Fuchs, Compton, Fuchs, Bryant, 2008). In addition, the measures should yield scores with sufficient technical adequacy, particularly in terms of alternate-form reliability, criterion-related validity, and sensitivity to growth (National Center on Intensive Intervention, www.intensiveintervention.org).

For writing assessment, the types of writing tasks and scoring procedures should be taken into account for choosing appropriate and effective progress monitoring measures, because different types of tasks and scoring procedures have appeared to be more appropriate depending on students' writing levels and the purpose of assessment (Ritchey & Coker, 2013). For example, writing tasks that are too easy or too challenging for students would show ceiling or floor effects, and the measures might not show growth in writing (Lembke, Deno, & Hall, 2003). In addition, it is necessary to choose appropriate scoring procedures, given that different scoring procedures reflect different aspects of writing in terms of productivity, accuracy, or quality of writing (Ritchey & Coker, 2013).

To examine the potential use of CBM-W for beginning writers for progress monitoring and to identify a viable tool that could be used within a DBI framework, I reviewed the relevant research in this area. First, I describe criteria to determine adequacy of technical features in terms of alternate-form reliability, criterion-related validity, and sensitivity to growth. Then, I review findings from research on technical adequacy of CBM-W, with specific attention to types of tasks and scoring procedures. Given that there are more appropriate types of writing tasks and scoring procedures depending on levels of writing, the literature was reviewed by types of CBM-W tasks and scoring procedures at letter-, word-, sentence-, and discourse levels.

Criteria to Determine Technical Adequacy of CBM-W

To be useful for progress monitoring, CBM-W tasks should have sufficient reliability and criterion validity (Deno, 1985). No absolute criteria are provided in the literature; thus, for this review I followed criteria established by previous CBM-W researchers. Specifically, previous researchers (e.g., McMaster & Espin, 2007; McMaster, Du, & Pétursdóttir, 2009; McMaster, Du, et al., 2011) have used a minimum criterion of $r = .70$ for sufficient alternate-form reliability, and $r = .50$ for sufficient criterion validity. The reliability criterion of .70 was identified based on findings that sufficient reliability coefficients for standardized writing measures have typically ranged from .70 to above .90 (Taylor, 2003). The validity criterion of .50 was determined based on two considerations: "(1) a general rule that correlations of $r < .60$ should be interpreted with caution and (2) the fact that writing measures have historically yielded modest criterion-validity coefficients" (McMaster et al., 2009, p. 52). McMaster et al. (2009) used the validity criterion of .50 to avoid missing potential promising prompts. For sensitivity to growth, CBM-W should capture students' writing improvement when it actually occurs in a brief period of time. To consider the utility of CBM-W for students who need the most intensive individualized intervention within a DBI framework, evidence showing sensitivity to weekly or bi-weekly growth was considered as the most promising.

Research on Technical Adequacy of CBM-W

Deno and colleagues examined the criterion-related validity of Story prompts or Picture prompts with other criterion measures in writing (Deno, Mirkin, & Marston, 1980; Videen, Deno, & Marston, 1982). Story prompts showed relatively less strong validity coefficients for early elementary students (*r* = .34 to .67) than those for upper elementary students (*r* = .41 to .88). To address the need for writing measures that are appropriate for beginning writers, more recently, several researchers have developed alternative CBM-W tasks (Coker & Ritchey, 2010; Hampton, Lembke, & Summers, in press; Lembke et al., 2003; McMaster et al., 2009; McMaster, Du, et al., 2011; Ritchey, 2006; Ritchey & Coker, 2013).

Type of CBM-W tasks. Researchers have developed early writing CBM tasks for letter, word, sentence, and discourse levels based on the *simple view of writing* model (McMaster, Ritchey, et al., 2011).

Letter-level CBM-W tasks. Two writing tasks, Letter Writing and Sound Spelling, were developed to assess letter-level writing (Ritchey, 2006). The writing tasks require students to write an uppercase and lowercase letter when the name or sound was given. Internal consistency coefficients and split-half reliability of the two writing tasks were sufficient for students in kindergarten (*r* = .82 to .94, *r* = .90 to .92 respectively). The two writing tasks showed sufficient criterion-related validity with CBM-reading and norm-referenced reading assessments: the Woodcock Reading Mastery Test (WRMT, Word Identification subtest, Woodcock, 1998) and the Test of Early Reading Ability (TERA, Reid, Hresko, & Hammill, 2001); *r* = .54 to .72 and *r* = .53 to .77 respectively. In terms of sensitivity to growth, the writing tasks captured writing improvement for the majority of students (about 85%) across an 8-week interval (Ritchey, 2006).

Word-level CBM-W tasks. Word-level writing tasks request students to copy or write real and pseudo-words from dictation, or write words starting with a given letter (Hampton et al., in press; Lembke et al., 2003; McMaster et al., 2009, Study 1; Ritchey, 2006). Five writing tasks were developed: Word Copying, Word Dictation, Real Word Spelling, Nonsense Word Spelling, and Letter prompts. Among the five tasks, Word Dictation, Real Word Spelling, and Nonsense Word Spelling appeared having sufficient reliability and validity.

Word Dictation yielded sufficient alternate-form reliability for first graders (r = .75 to .95; Hampton et al., in press). Criterion-related validity appeared sufficient with over half of atomistic variables (r = .76 to .92) and the Test of Early Written Language-2 (TEWL-2, Hresko, Herron, & Peak, 1996, r = .61 and .59), but not sufficient with most holistic variables (Hampton et al., in press; Lembke et al., 2003). Real Word Spelling and Nonsense Word Spelling prompts yielded sufficient alternate-form reliability (r = .84 and r = .89, Ritchey, 2006) and criterion-related validity, ranging from .50 to .81 with CBM-reading, and approximately .50 to .60 with the TERA (Reid et al., 2001).

In terms of sensitivity to growth, Word Dictation produced scores dispersed with a wide range of standard deviations, and no floor or ceiling effects were detected (Hampton et al., in press; Lembke et al., 2003). The results indicate a potential use of the writing task to discriminate among students with different levels of writing with room to capture growth. Further, Word Dictation detected significant bi-weekly growth in writing for first grade students. Real Word Spelling and Nonsense Word Spelling prompts were able to detect growth in writing for a majority of students (about 85%) at 8 weeks interval

(Ritchey, 2006). Converging evidence suggests that, among the three word-level tasks, Word Dictation appears the most promising to be used for progress monitoring on at least a bi-weekly basis.

Sentence-level CBM-W tasks. Sentence-level writing tasks involve copying or dictating sentences, and generating sentences prompted by pictures (Coker & Ritchey, 2010; Hampton et al., in press; Lembke et al., 2003; McMaster et al., 2009; McMaster, Du, et al., 2011). Sentence Copying, Sentence Dictation, and Picture Word prompts were developed. Among the four writing tasks, the first three have shown sufficient reliability and criterion-related validity.

Overall, Sentence copying yielded sufficient test-retest reliability and alternate-form reliability for first grade students (r = .71 to .89 and .70 to .93 respectively; Hampton et al., in press; McMaster et al., 2009, Study 2; McMaster, Du, et al., 2011). Criterion-related validity was sufficient with atomistic variables (r = .74 to .81), the TEWL-2 (Hresko et al., 1996, r = .51 and .61), teacher ratings and a district rubric (r = .56 to .70, Hampton et al., in press; Lembke et al., 2003; McMaster et al., 2009, Study 2), but not sufficient with holistic variables and the Test of Written Language, Third Edition (TOWL-3, Hammill & Larsen, 1996; $r < .50$, Lembke et al., 2003; McMaster et al., 2009, Study 1; McMaster, Du, et al., 2011).

Sentence Dictation showed sufficient alternate-form reliability for first graders in general (r = .76 to .98). Criterion-related validity was sufficient with most atomistic variables (r = .78 to .92) and with some holistic variables (r = .78 to .84; Lembke et al., 2003). The criterion-related validity was also sufficient with the TEWL-2, ranging from .51 and .53 (Hampton et al., in press).

Picture Word prompts yielded sufficient alternate-form reliability: approximately *r* = .70 to .80 (McMaster et al., 2009, Study 2; McMaster, Du, et al., 2011). Most criterion-related validity coefficients were sufficient with qualitative rubrics including teacher ratings and a district rubric (*r* = .52 to .60). With the TOWL-3, no significant or insufficient validity coefficients were found for different cohorts of first grade students (*r* = .23 to .50; McMaster et al., 2009, Study 2; McMaster, Du, et al., 2011).

In terms of sensitivity to growth, Sentence Copying and Sentence Dictation showed no ceiling or floor effects. The two tasks were sensitive to bi-weekly writing growth for first graders (Hampton et al., in press; Lembke et al., 2003). In addition, Sentence Copying and Picture Word prompts appeared to be sensitive to writing growth at three-month intervals (McMaster et al., 2009). McMaster, Du, et al. (2011) provided further evidence for Sentence Copying and Picture Word prompts by examining reliability and validity of slopes using incremental slopes by adding a weekly data point. The researchers found that at least eight data points were needed to obtain reliable and stable slopes from the two writing tasks. Picture Word prompts needed at least three or four points to detect significant weekly writing growth. According to converging findings, Picture Word prompts appear the most promising sentence-level progress monitoring measure with sufficient reliability and validity, and sensitivity to weekly growth.

Discourse-level CBM-W tasks. For discourse-level writing, students write a story or essay for an open-ended Story prompt or for a series of pictures or photos that convey a common theme or a sequential event (McMaster et al., 2009, Study 1; McMaster, Du, et al., 2011; Ritchey & Coker, 2013). The tasks include Story prompts, Picture Story prompts, Picture Theme prompts, and Photo prompts (McMaster et al., 2009; McMaster, Du, et al., 2011; Ritchey & Coker, 2013). Among the four tasks, Story prompts and Photo prompts appeared to yield sufficient reliability and validity, and Picture Story prompts showed preliminary promising evidence of sufficient validity.

Story prompts yielded sufficient test-rest reliability coefficients ranged from .74 to .83 (McMaster et al., 2009, Study 1; McMaster, Du, et al., 2011). Alternate-form reliability yielded mixed results for different cohorts of first graders as being sufficient (r = .75 to .83) or not sufficient (r = .61 to .64, McMaster et al., 2009, Study 1; McMaster, Du, et al., 2011). Criterion-related validity was sufficient with teacher ratings, a district rubric, and the TOWL-3 for first grade students (r = .51 to .61, .56 to .64, and approximately .50 to .60 respectively, McMaster et al., 2009, Study 1; McMaster, Du, et al., 2011), but not sufficient with the Woodcock-Johnson III Tests of Achievement (WJ III, Woodcock, Mather, & McGrew, 2001) and teacher ratings for second and third grade students (r = .31 to .42, Ritchey & Coker, 2013). Photo prompts showed sufficient alternate-form reliability approximately ranged from .70 to .85. The criterion-related validity was sufficient with teacher ratings (r = .53 to .59) but not sufficient with a district rubric (r = .36 to .50). In general, Picture Story prompts showed insufficient criterion-related validity with the WJ III (Woodcock et al., 2001) and teacher ratings across grades 2 and 3 (Ritchey & Coker, 2013).

In terms of sensitivity to growth, Story prompts showed potential to detect significant growth in writing at three-month intervals for different cohorts of first graders (McMaster et al., 2009, Study 1; McMaster, Du, et al., 2011) and was sensitive to growth at bi-monthly intervals for combined second and third graders (Ritchey & Coker, 2013). In addition, significant grade-level differences were found with third grade students have shown outperformed second grade students (Ritchey & Coker). Photo prompts were sensitive to growth at three-month intervals for first graders (McMaster et al., 2009, Study 1; McMaster, Du, et al., 2011). Picture Story prompts were sensitive to bimonthly growth for combined grade 2 and 3 students (Ritchey & Coker). In sum, Story prompts, Picture Story prompts, and Photo prompts have showed promising features to be used as progress monitoring measures, at least on a bi-monthly or tri-monthly basis.

Scoring procedures. A variety of scoring procedures have been used to score students' writing samples of CBM-W. The scoring procedures were used as production (the total words written), production and accuracy (words spelled correctly, correct word sequences, correct minus incorrect word sequences, correct letter sequences, and correct minus incorrect letter sequences), or quality (Ritchey & Coker, 2013). Total words written (WW) is the total number of words written in a writing sample. Words spelled correctly (WSC) is the total number of correctly spelled words (Deno et al., 1980). Correct word sequences (CWS) is defined as any adjacent, correctly spelled words that are grammatically correct within the context of the sample and would make sense to a native speaker of English (Videen et al., 1982). Correct minus incorrect word sequences (CIWS) is calculated as the number of CWS minus the number of incorrect word sequences, which refers to any adjacent, incorrectly spelled or used words. Correct letter sequences (CLS) is defined as any two adjacent letters correctly spelled to the word (Deno et al., 1980). Correct minus incorrect letter sequences (CILS) is calculated as the number of CLS minus the number of incorrect letter sequences.

Production and accuracy indices have been used most frequently in the literature. WW and WSC were applied broadly for most writing levels at word-, sentence-, and discourse-level. CWS and CIWS were applied for sentence- and discourse-level, and CLS and CILS were applied for letter- and word-level writing. Based on findings above, appropriate scoring procedures were identified for types of CBM-W tasks that have shown the most promise for progress monitoring. Given that letter-level writing tasks need further evidence of sensitivity to growth on a regular basis, appropriate scoring procedures were identified below for all except for the letter-level CBM-W tasks.

Word-level CBM-W tasks. Word Dictation was identified as the most promise for progress monitoring on a bi-weekly basis for word-level writing. Word Dictation was scored for WW, WSC, CLS and CILS (Hampton et al., in press; Lembke et al., 2003). CLS and CILS yielded sufficient alternate-form reliability, ranging approximately from .80 to .90. The strongest criterion-related validity was found for CLS with atomistic variables (r = .76 to .87) and for WSC with holistic variables (r = .83). Sufficient criterion-related validity was found for CLS and CILS with the TEWL-2 (r = .61, .59).

Thus, overall, CLS or CILS appeared appropriate scoring procedures for progress monitoring using Word Dictation.

Sentence-level CBM-W tasks. Picture Word prompts were identified as the most promising task to be used for weekly progress monitoring. Picture Word prompts were scored for WW, WSC, CWS, CIWS, and CLS (McMaster et al., 2009, Study 2; McMaster, Du, et al., 2011). Alternate-form reliability was sufficient across scoring procedures for first graders (r = .70 to .79). For a different cohort of first graders, CWS showed the strongest alternate-form reliability (r = .77, McMaster, Du, et al., 2011). In addition, CWS showed the most promising criterion-related validity with qualitative scores and a norm-referenced writing assessment. The validity coefficients were sufficient with teacher ratings and a district rubric (r = .60 and .52 respectively), but not sufficient with the TOWL-3 (r = .49, McMaster et al., 2009, Study 2; McMaster, Du, et al., 2011). Overall, CWS has provided promising evidence as an appropriate scoring procedure for progress monitoring using Picture Word prompts.

Discourse-level CBM-W tasks. Story prompts, Photo prompts, and Picture Story prompts provided promising evidence for assessing discourse-level writing. Story prompts were scored by WW, WSC, CWS, CIWS, and CLS (McMaster et al., 2009, Study 1; McMaster, Du, et al., 2011). The test-retest and alternative form reliability were sufficient for CWS or CLS (r = .70 to .83 and .64 to .84 respectively). For a different cohort of first graders, CWS showed the strongest correlations with the TOWL-3 (r = .63; McMaster, Du, et al., 2011). Photo prompts showed sufficient alternate-form reliability across different scoring procedures (r = .72 to .85, McMaster et al., 2009, Study 1). Criterion-related validity was strongest for CWS with teacher ratings and a district rubric. Picture Story prompts were scored for WW, WSC, CWS, and qualitative rubric (Ritchey & Coker, 2013). CWS and a qualitative rubric showed sufficient criterion-related validity with teacher ratings for third grade students (over $r = .50$). In addition, CWS showed the largest rate of bimonthly writing growth by 2.98 for combined grade levels including second and third grades. Overall, converging evidence has supported the use of CWS to be used for progress monitoring across three different prompts: Story prompts, Picture Story prompts, and Photo prompts.

Summary

In sum, based on findings above, a total of five CBM-W tasks were identified as being promising for progress monitoring: Word Dictation (at word-level writing), Picture Word prompts (at sentence-level writing), Story prompts, Photo prompts, and Picture Story prompts (at discourse-level writing). Given that technical adequacy of Photo prompts and Picture Story prompts have only been examined once so far (McMaster et al., 2009, Study 1; Ritchey & Coker, 2013), additional research is necessary to strengthen the preliminary evidence. Thus, the most promising CBM-W tasks along with the most appropriate scoring procedures for progress monitoring appears to be Word Dictation with CLS or CILS, Picture Word prompts with CWS, and Story prompts with CWS. Thus, to make better the effects of DBI in early writing, the type of tasks and scoring procedures identified as the most appropriate for progress monitoring should be used depending on students' level of writing.

Implications

Taken together, studies reviewed above regarding effective features of DBI, along with early writing intervention and assessment, suggest the potential of DBI to improve beginning writing performance of students identified as at risk or with disabilities related to writing. In previous research, the effects of DBI have been examined in reading, mathematics, and spelling, but not in early writing. Studies regarding implementation of research-based early writing intervention have supported the positive effects of early writing intervention focusing on transcription skills (handwriting and spelling) to increase the compositional quantity and quality of beginning writers. In examining the effects of DBI in early writing, systematic progress monitoring and a data-based decision making process are essential, implying a need for appropriate progress monitoring tools that produce data that are reliable, valid, and sensitive to growth in writing. Research examining the technical adequacy of early writing measures of CBM has, in general, found promising evidence of the writing tasks and scoring procedures.

While the potential of DBI in early writing intervention exist, several factors might influence the feasibility of implementing DBI in schools. First, teachers may experience difficulties implementing DBI, given that DBI is a framework with multiple components and a series of steps. In previous research, many teachers expressed difficulties with making instructional changes and designing instructional plans reflecting those changes (Tindal et al., 1981). Second, the nature of CBM for progress monitoring might make teachers hesitant to implement DBI. Special education teachers identified a time-consuming feature as a primary factor inhibiting their use of CBM (Wesson, King,

& Deno, 1984). In particular for CBM in writing, scoring students' writing samples using different scoring procedures is a complex and time-consuming task (Hosp, Hosp, & Howell, 2006). The average scoring time has been reported to be about 90 to 150 seconds per writing sample for elementary students and, the scoring time spent varies depending on length of writing sample, type of writing tasks, scoring experience of scorers, and students' grade levels (Hosp et al., 2006; Malecki & Jewell, 2003).

To address the first barrier inhibiting teachers to implement DBI, providing ongoing consultation might be helpful. In most studies that have shown promising evidence of DBI, researchers provided ongoing supports for teachers throughout the period of study after the initial DBI training. During the consultation sessions, fidelity of DBI steps was checked, and teachers received instructional guidance and recommendations from trained consultants (Stecker et al., 2005). These ongoing supports might play an important role to ensure the procedural integrity of DBI including the difficulties that special education teachers have expressed with respect to instructional decision making based on data and instructional changes. There is, as of yet, no consensus on the specific types of support systems that are most effective. Any forms of ongoing supports, however, should be provided to the DBI implementers in order to maximize the likelihood of positive effects. For the second barrier related to the nature of CBM, developing alternative administration and scoring procedures such as computerized system might be useful (L. Fuchs, 1988; Stecker & Fuchs, 2000).

To date, there has been no research conducted examining the effects of DBI in early writing intervention for improving beginning writing performance of students who are identified as at risk or with disabilities that relate to writing. Information regarding the extent to which DBI is feasible would provide useful information to enhance its sustainability of implementation in schools. Thus, in addition to examining the effects of DBI in improving early writing outcomes of students at risk or with disabilities, in this dissertation I also examine the extent to which it is perceived as being feasible to implement.

CHAPTER III

METHODS

Research Design

A pretest-posttest control group design was used to examine the effects of DBI by special education status and type of writing skills on students' writing performance. Students identified as in need of intensive writing instruction by teacher nomination and screening procedures were assigned randomly within classroom to experimental (DBI) or control conditions (detailed screening procedures are described under "Procedures"). Student participants were from either general education classrooms or special education classrooms, and were placed in a small group of three to four students within the same classroom. Thus, given the nature of random assignment within classrooms, students from general education classrooms were assigned randomly with students from the same grade, while students from special education classrooms were assigned randomly with students from multiple grade levels. Students assigned to the treatment condition received early writing intervention along with DBI process, while control students continued to receive their business-as-usual instruction.

Setting and Participants

District and Schools

The study was conducted in a large urban district serving 34,400 K-12 students in 71 schools. The district consisted of 32.8% White, 36.2% African American, 18.8% Hispanic, 7.6% Asian, and 4.6% American Indian students. Nineteen percent of the students were receiving special education services, 21% were receiving English language services, and 65.6% were receiving free and reduced lunch service. Three elementary schools in the district participated in the study. School demographic information is summarized in Table 2.

Table 2

School Demographics

	White (%)	African American (%)	Hispanic (%)	Asian (%)	American Indian (%)	SPED (%)	ELL (%)	FRL (%)
School A	14	45	34	3	4	15	54	89
School B	7	76	6	3	8	17	59	91
School C	7	66	3	21	2	22	15	91

Note. SPED = students receiving special education services; ELL = English language learners; FRL = students receiving free reduced lunch.

Teachers

Teachers within the district, who were working with students in first through third grades identified as at risk for experiencing writing difficulties or having disabilities that affected their writing achievement, were invited and recruited to participate in the study. With the assistance of a special education administrator in the district, a research invitation email was sent to school principals first, and then, distributed to all special education teachers working with students who were potentially eligible. Fourteen teachers responded to this initial email communication showing interest with additional questions requesting clarification. After a second round of email communication was conducted by responding to their questions, a face-to-face meeting was scheduled. In this meeting, the principal investigator provided an overview of the study along with specific steps of DBI and described expectations for teachers. Teachers who agreed to participate in the study helped research staff identify potentially eligible students, collect students' demographic information, and coordinate schedules for administering assessments and implementing DBI (including pre- and post-testing, writing intervention, and classroom observations).

Seven teachers agreed to participate in the study, including four special education teachers and three elementary education teachers (one first-grade and two second-grade classroom teachers). Demographic information was collected from the teachers. Teacher demographic information is presented in Table A1 in Appendix A.

Tutors

Undergraduate and graduate students studying in the departments of Educational Psychology, Curriculum and Instruction, and Psychology at the University of Minnesota were recruited to serve as tutors through an invitation email and personal connection. Tutor candidates participated in an individual interview with the principal investigator for 20 to 30 min. The interview consisted of questions about their willingness and availability to commit time to implement DBI and attend regular weekly meetings, teaching experience with students in K-12 or working with young students, managing behavior of students with behavior issues, English language proficiency, availability to use self transportation, and fit of their interests and goals with the study. A total of six tutors who had experience teaching or working with young students were recruited (including the principal investigator). Tutor demographic information is presented in Table 3.

Table 3

Tutor Demographics

	Tutors (*n* = 6)	
	n	%
University Status		
Undergraduate	3	50.0
Graduate	3	50.0
Sex (female)	4	66.7
Race		
White	3	50.0
Asian	3	50.0
Age		
20-29	5	83.3
30-39	1	16.7
Highest Degree		
High school diploma	3	50.0
Bachelor's	1	16.7
Master's	1	16.7
Master's plus additional coursework	1	16.7
	M (range)	*SD*
Years of experience teaching K-12	3.0 (0-7)	2.6
Years of experience teaching students who receive special education service	2.38 (0-10)	3.9
Years of experience working with youth (other than teaching)	1.50 (0-3)	1.1
Hours of PD in writing assessment and/or writing instruction	51.00 (5-185)	69.7

Note. Hours of PD = hours in professional development the tutors have received in the last year in the area of writing assessment and/or instruction.

Students

This study was originally powered to examine the effects of DBI on students' writing performance using one-between multivariate analyses of variance (MANOVA), with treatment (DBI versus control) as the between-groups factor.[1] A power analysis was conducted for "MANOVA: global effects" with two groups using G*Power 3.1.9.2 version. This power analysis indicated that a sample size of $n = 36$ would be necessary to indicate adequate power (1- β error probability = .95) to detect an effect size of $d = .50$ when α rate is set to be .05.

Students in the classrooms of the consented teachers were invited. Teachers were asked to nominate students who struggled with writing or were identified as having disabilities that affected their writing. A parental consent form was distributed to the students who were nominated by their classroom teachers ($n = 66$). Students took the consent forms home and got their parents' signature on the forms. The parents could choose either 'yes' or 'no' for their children to participate. Students who returned the consent forms with their parents' signature received gel pens. Distribution and return rates of parental consent forms for each school are summarized in Table 4. Student demographic information was collected by requesting data from the school district. Student demographic information is presented in Table 5. Chi-square analyses showed no significant differences between DBI and control conditions for each student demographic variable. The mean age was 7.93 years (range = 6.69 years to 9.19 years) for students in the treatment condition and 7.70 years (range = 6.27 years to 9.52 years) for students in the control condition. There was no significant difference in mean age between conditions ($t[44] = .88$, $p = .39$).

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[1] It should be noted that after conducting the study, the original research question was slightly changed to examine differential effects of DBI on students' writing performance depending on two variables, special education status and types of writing skills.

Table 4

Distribution and Return Rates of Parental Consent Forms

	Distributed	Returned indicating 'Yes' or 'No' to participation			Return Rate
		Yes	No	Total	
School A	39	26	1	27	69%
School B	17	15	0	15	88%
School C	10	8	0	8	80%

Table 5

Student Demographics

Variable	DBI (n = 22)		Control (n = 24)			
	n	%	n	%	X^2	p
Age in years					4.61	.20
6 years	4	18.2	5	20.8		
7 years	7	31.8	13	54.2		
8 years	7	31.8	2	8.3		
9 years	4	18.2	4	16.7		
Grade					3.30	.19
Grade 1	7	31.8	13	54.2		
Grade 2	11	50.0	6	25.0		
Grade 3	4	18.2	5	20.8		
Sex					0.55	.46
Male	16	72.7	15	62.5		
Female	6	27.3	9	37.5		
Race					2.65	.62
American Indian	1	4.5	0	0.0		
African American	14	63.6	14	58.3		
Asian	2	9.1	1	4.2		
Hispanic	1	4.5	3	12.5		
White	4	18.2	6	25.0		

Variable	DBI (n = 22)		Control (n = 24)			
	n	%	*n*	%	X^2	*p*
Table 5, cont.						
FRL					0.46	.50
No FRL	2	9.1	1	4.2		
Receives FRL	20	90.9	23	95.8		
SPED					0.00	.96
No IEP	9	40.9	10	41.7		
Has IEP	13	59.1	14	58.3		
Disability Categories					5.07	.65
ASD	4	30.8	4	28.6		
SNAP	6	46.2	5	35.7		
S/LI	1	7.6	0	0.0		
OHD	1	7.6	3	21.4		
PI	0	0.0	1	7.1		
DCD-MM	0	0.0	1	7.1		
EBD	1	7.6	0	0.0		
ELL status					0.95	.33
Non-ELL	15	68.2	13	54.2		
ELL	7	31.8	11	45.8		
Home Language					5.96	.54
Arabic	0	0.0	1	4.2		
Amharic	1	4.5	0	0.0		
English	14	63.5	13	54.2		
Hmong	1	4.5	1	4.2		
Nepali	1	4.5	0	0.0		
Spanish	1	4.5	3	12.5		
Somali	3	13.6	6	25.0		
Tigrinya	1	4.5	0	0.0		

Note. DBI = data-based instruction; FRL = free reduced lunch; SPED = special education status; IEP = individualized education program; ASD = autism spectrum disorders; SNAP = student needing alternative programming; S/LI = specific language impairment; OHD = other health disabilities; PI = physical impairment; DCD-MM = developmental cognitive disabilities in the mild to moderate; EBD = emotional behavioral disabilities; ELL = English language learner.

Measures

A variety of measures were administered at different time points during the study for screening, pre- and post-testing, progress monitoring, checking the fidelity of DBI (both DBI steps and early writing intervention), and surveying feasibility of DBI. Measures used in this study, including the name of the measure, purpose, and administration time points, are outlined in Table 6. Note that data from progress monitoring measures (CBM-W Picture Word and Word Dictation) were not used as outcome data for this study; they were used for instructional decision making only.

Table 6

Measures: Purpose and Administration Time Points

Measures	Purpose	Administration Time Points
CBM-W Picture Word	Screening	Early January
	Pre- and posttest	Early January, late May
	Progress monitoring	Mid January to late May (for 12 weeks)
CBM-W Word Dictation	Progress monitoring	Mid January to late May (for 12 weeks)
WJ III		
Spelling	Pre- and posttest	Early January, late May
Writing Fluency	Pre- and posttest	Early January, late May
Writing Samples	Pre- and posttest	Early January, late May
AIRS	Fidelity check of DBI steps	March, April
Writing Intervention Checklists	Fidelity check of early writing intervention	March, April
Feasibility Survey	Assess tutors’ perceptions of the feasibility of DBI	Early June

Note. CBM-W = curriculum-based measures in writing; WJ III = Woodcock-Johnson III Tests of Achievement; AIRS = accuracy of implementation rating scale; DBI = data-based instruction.

CBM-W Picture Word

Picture Word prompts (McMaster et al., 2009; McMaster, Du, et al., 2011) were designed to capture sentence-level writing performance. Picture Word, which has shown sufficient technical adequacy in terms of reliability, validity, sensitivity, and classification accuracy (Jung & McMaster, 2012; McMaster et al., 2009; McMaster, Du, et al., 2011), was used for screening, pre- and post-testing, and monitoring students' progress in the study. Three alternate prompts were administered in a small group of two students or individually for screening and pre- and post-testing. For progress monitoring, one prompt was administered each time. The Picture Word prompts consisted of words with a picture above each word. Each prompt consisted of nine words with three words per page and a big stop sign at the end of each prompt.

Before the task began, the examiner showed a picture of dog on a paper with the name of the object underneath. The examiner asked students to generate a sentence using the word and wrote the sentence on the paper. If students generated an incorrect sentence that did not make sense or did not include the target word in the sentence, the examiner provided corrective feedback. After practice with the sample item, the examiner demonstrated how they should complete the entire Picture Word prompt with an administrator copy and explained how to deal with spelling difficulties while taking the test. The examiner asked students to point to each word in the prompt with their finger as the examiner read the word, and instructed them to write as many sentences as possible. After 3 min, students stopped writing and raised their pencils in the air (to show they had stopped), and the examiner circled the last letter each student wrote. If students finished writing sentences earlier than 3 min, the examiner wrote the exact time spent on the last page of each prompt. This entire procedure was repeated for the other two alternate Picture Word prompts (see Appendix B for administration directions and a sample Picture Word prompt).

Writing samples used for pre- and post-testing purposes were scored using four different scoring procedures: words written (WW), words spelled correctly (WSC), correct word sequences (CWS), and correct minus incorrect word sequences (CIWS). WW is the total number of words written in a writing sample. WSC is the total number of correctly spelled words (Deno et al., 1980). CWS is defined as any adjacent, correctly spelled words that are grammatically correct within the context of the sample and would make sense to a native English speaker (Videen et al., 1982). CIWS is calculated as the number of CWS minus the number of incorrect word sequences, which refers to any adjacent, incorrectly spelled words. Every writing sample used for progress monitoring purpose was scored using CWS.

Alternate-form reliabilities scored by WW, WSC, CWS, and CIWS have been reported to be moderate to strong (r = .59 to .79, r = .61 to .76, r = .58 to .77, and r = .44 to .58 respectively) for first grade students (n = 50, McMaster et al., 2009). Criterion-related validities with the Test of Written Language, Third Edition (TOWL-3, Hammill & Larsen, 1996) have been reported as r = .23 to .29 for WW, r = .29 to .43 for WSC, and r = .39 to .54 for CWS (McMaster, Du, et al., 2011). For other criterion measures, criterion-related validities have ranged from r = .49 to .60 with teacher ratings, and r =

.37 to .54 with a district rubric across WW, WSC, and CWS (McMaster et al., 2009). No criterion validity information of CIWS has been reported in the literature.

CBM-W Word Dictation

Word Dictation was designed to assess word-level writing skills (Lembke et al., 2003). Word Dictation was used as a progress monitoring measure in this study for students who could generate whole words but could not generate sentences, with the assumption that Word Dictation would be more sensitive to growth made in a short time period. Word Dictation contained 20 words randomly sampled from six types of word patterns per each prompt: consonant-vowel-consonant (CVC), consonant-consonant-vowel-consonant (CCVC), consonant-vowel-consonant-silent e (CVCe), consonant-consonant-vowel-consonant-silent e (CCVCe), consonant-consonant-vowel-consonant-consonant (CCVCC), and consonant-vowel-vowel-consonant (CVVC) words. Irregular words frequently used in students' writing were also added (Graham, Loynachan, & Harris, 1993).

Word Dictation was administered individually for 3 min. Each student was asked to write a word while the examiner said the word two times. The examiner demonstrated how the student should proceed through the task. When the student paused on a word for more than 5 seconds, the examiner moved to the next word. Writing samples were scored using WW, WSC, CLS, and CILS. WW and WSC were the same scoring procedures used for Picture Word. CLS was defined as any two adjacent, correctly spelled letters (Tindal & Marston, 1990). CILS was calculated by the number of correct letter sequences minus the number of incorrect letter sequences, which refers to any adjacent, incorrectly dictated letters (see Appendix B for administration directions and a sample Word Dictation prompt).

Alternate form reliability was reported as ranging from *r* = .58 to .97 for correct sequences, .79 to .95 for correct minus incorrect sequences (Hampton et al., in press). Criterion validity was moderate to strong, with correlation coefficients with atomistic criteria ranging from *r* =.61 to .80 for WW, *r* =.76 to .87 for WSC, and *r* = .82 to .92 for CLS. Criterion validity coefficients with holistic criteria were moderate to high, but most correlation coefficients were not significant except for WSC (*r* = .83, Hampton et al., in press).

Woodcock-Johnson III Tests of Achievement

Woodcock-Johnson III Tests of Achievement (WJ III; Woodcock et al., 2001) writing subtests (Spelling, Writing Fluency, and Writing Samples) were administered to all participants at pre and posttest.

The Spelling subtest required individual students to write letters or words of increasing difficulty that the examiner dictated. Different grade levels had a different starting point of items. The examiner establishes basal and ceiling by administering items until the student correctly spelled six items in a row (basal) and stopping when the student incorrectly spelled six words in a row (ceiling). Each item was scored as 1 if correct and 0 if incorrect based on answer keys in the examiner’s manual (Mather & Woodcock, 2001). The total score was calculated by adding each point. Items prior to the established basal were considered as correct answers.

The Writing Fluency subtest measured students' skills in writing simple sentences quickly and accurately in response to a picture stimulus. As practice, students were asked to write a sentence containing three words, which were presented beside a picture stimulus, for three sample items. Each sentence was scored 1 as being a complete and reasonable sentence with the three words included, and 0 for not meeting these criteria. If students got a score of 0 for all the three sample items, the test was discontinued. If students got a score of 1 for at least one item, they were given additional picture stimuli and were asked to write a sentence including three words as quickly as possible within 7 min. A total score was calculated by adding each score.

The Writing Samples subtest measured students' writing skills at word-, phrase-, and sentence-levels by accounting for quality of expression. Students were asked to write words or sentences in response to a picture or a verbal stimulus. Six to 12 items in different testing blocks were administered to students depending on their grade levels. Specific scoring criteria for each item were given in an examiner's manual (Mather & Woodcock, 2001) and scored from 0 to 2 depending on the degree to which they met the scoring criteria.

An aggregated score of Spelling, Writing Fluency, and Writing Samples represented as a Broad Written Language cluster, which provided a comprehensive measure of written language achievement. The raw scores of each subtest were converted to *W* scores using the WJ III Compuscore® and Profiles Program (Schrank & Woodcock, 2001). The median reliability coefficients of each subtest were reported as ranging from .84 to .89 (r = .89 for Spelling, r = .86 for Writing Fluency, and r = .84 for Writing

Samples in the age 5 to 19). The median reliability of the Broad Written Language Cluster was .94 (Mather & Woodcock, 2001).

Accuracy of Implementation Rating Scale (AIRS)

To examine whether DBI steps were implemented as intended, the Accuracy of Implementation Rating Scale (AIRS, Fuchs et al., 1984) was modified for DBI in early writing (see Appendix C). The AIRS consisted of five parts corresponding to implementation of DBI steps:

1) "*Administering the Assessment*," for checking whether the examiner administered CBM-W with accuracy in terms of preparing testing materials, following the directions, overall demonstration skills in terms of clearness and responsiveness, and timing;
2) "*Scoring the Assessment*," for checking the accuracy of a scoring procedure used for progress monitoring;
3) "*Documenting Assessment Outcomes*," for inspecting CBM-W graphs in terms of formatting the graphs and plotting students' scores on the graphs;
4) "*Using Assessment Outcomes*," for examining whether the tutors applied data-based decision rules and made instructional changes appropriately; and
5) "*Implementing Writing Instruction*," for checking the overall components of writing intervention delivered as intended. Fidelity of specific procedures of each writing activity was examined using a different form (*Writing Intervention Checklists;* see below for details).

Each item was rated as 0 (not observed) or 1 (observed), along with observation notes for each item. Raters checked “Yes” if they observed the item or “No” if they did not observe the item, and wrote detailed notes regarding other components they observed.

Writing Intervention Checklists

Writing Intervention Checklists were generated to examine the accuracy of implementing the early writing intervention. Based on specific writing activities delivered for each session, three checklists were developed (see Appendix D). Each checklist contained items corresponding to specific steps of each writing activity. Introduction and closing components were included as common across the checklists. Similar to the AIRS, each item was rated as 0 (not observed) or 1 (observed), and observation notes for each item were made.

Feasibility Survey

At the end of the study, the DBI tutors were asked to complete a feasibility survey regarding the utility of DBI steps for early writing intervention (see Appendix E). The survey consisted of three sub-categories: feasibility, usefulness, and overall satisfaction. Each category comprised seven items related to DBI steps (“Identifying written expression strengths and weaknesses using CBM-W probes and other information,” “Generating hypothesis about appropriate method to individualize instruction for the student,” “Choosing an instructional option from Data-Based Decision Making (DBDM) rubric based on the hypothesis generated,” “Creating a Change of Instructional Plan (CIP) for each student or group of students,” “Beginning writing instruction using the CIP,” “Monitoring progress monitoring twice a week, including scoring and graphing,” and “Making ongoing changes in instruction based on decision-making rules”); and one open-ended item (How could the feasibility/usefulness/your overall satisfaction with DBI be improved for instructional decision making for beginning writers). Items to be rated were on a 1-4 Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree).

Data-Based Instruction (DBI) in Early Writing

DBI in early writing consisted of the early writing intervention along with DBI steps. The tutors were asked to implement the early writing intervention emphasizing handwriting and spelling activities by applying the eight steps of DBI. The tutors were also asked to keep a log of students’ attendance and contents covered during the day to determine whether students received the intervention with adequate dosage.

Early Writing Intervention

Early writing intervention was adapted from a manual from the Center on Accelerating Student Learning (CASL) handwriting and spelling program developed by Dr. Graham and Dr. Harris at the University of Maryland (Graham & Harris, 1999). The manual comprised writing activities supported by empirical research as effective handwriting and spelling interventions (Graham et al., 2002; Graham et al., 2000). The early writing intervention consisted of 10 units, and each unit had six lessons. Each unit covered different target sounds/letters, rimes, and words, but followed the same format. There were seven writing activities: Phonics Warm-up, Alphabet Practice, Word Building, Word Study, Alphabet Rockets, Writing, and Word Sort. The first six activities were delivered across lessons 1 to 5, and the Word Sort activity was delivered in lesson 6 (see Appendix F for the overview of writing intervention). The first six activities were taught across two sessions; thus, three activities were delivered per session. For example, in session 1, students received Phonics Warm-up, Word Building, and Alphabet Rockets activities. In session 2, students received Alphabet Practice, Word Study, and Writing activities. All writing activities comprised a similar structure starting with modeling, guided practice, and independent practice (see Appendix G for Writing Instructional Plans for lesson 1 and lesson 6).

The Phonics Warm-up activity was designed to improve students' skills in correctly identifying letter(s) corresponding to the sounds for short vowels, consonants, blends, and digraphs. Students worked with four sets of picture cards including a picture on the front page and a word on the back page indicating a target sound/letter(s) as underlined. The target sound/letter(s) were located at the beginning, middle, and end of a word. In the Phonics Warm-up activity, the instructor showed a picture on the front page and asked the name of the picture, said the sound and location of the target letter(s), and asked students the sound and location again. For example, if a target sound was /a/ located at the beginning of a word, the instructor asked "The first sound of [*apple*] is /a/." "What sound?" "What letter makes the /a/ sound?" If students did not provide correct response to the questions, the instructor gave immediate corrective feedback.

The Alphabet Practice activity was designed to help students write the alphabet letters correctly and effectively. Students practiced writing three target letters and writing words containing the three letters. The instructor modeled how to write the target letter on an alphabet card by tracing it with his/her finger while describing the process aloud, and had students trace each letter on the alphabet card. Each letter with numbered arrows was printed on the alphabet card. Students had time to discuss similar and different features of the target letter by comparing two letters each. Students practiced writing letters on a worksheet while saying the letter(s) aloud. After repeated practice of writing letters, the instructor covered the letters and asked students to write the letters from their memory. Students were asked to circle the best letter(s) written. Students practiced writing words that contained the target letters on a worksheet in the same way as they did for writing letters. They wrote words while saying the words aloud, and circled the best word(s) written. Lessons 1 and 2 involved in letter writing. Lesson 3 and 4 involved in writing commonly used words that contain the letters, and lesson 5 involved in writing hinky-pinks, a combination of two silly words that required repeated practice of target letters (e.g., willy-nilly). The target letters were grouped and were arranged in order based on ease of writing, frequency of occurrence, and confusability (Graham et al., 2000). The easiest writing and the most frequently used letters appeared first, and difficult writing and less frequently used letters appeared last. Letters that could be easily confused or reversed were not grouped together (e.g., letter *b* and *d*, *p* and *q*) and were arranged separately in a distance.

The Word Building activity was designed to practice generating words by adding a letter at the beginning of rimes. Two rimes were introduced per unit, and the paired two rimes were to instruct specific spelling principles. The instructor showed a rime, said the sound of the rime, and modeled how to make a real word by adding a letter in front of the rime. After modeling, the instructor had students make as many real words as possible and say the words out loud. If students made non-real words, the instructor gave immediate corrective feedback by saying, "I know you made the word (*insert a word that students made*). Think about (*insert a word that students made*) as a real word." Lesson 1 and 3 introduced a new rime and used letter cards to make real words. Lesson 2 and 4 practiced the rime introduced in the previous lessons and used a worksheet to write the words that they made. Lesson 5 reviewed the two rimes and made words by writing on a worksheet.

The Word Study activity was designed to study words through a series of five steps. The five steps included (1) saying a word and its letters, (2) saying the word and letters from memory while they closed their eyes, (3) saying the letters again, (4) writing the words from memory, and (5) checking to see if they wrote the word correctly and writing the word two more times if it was correct. If students misspelled a word, they were instructed to correct the word. Every student studied five words per session. Words were removed and replaced if students mastered the words. Words were considered as mastered if students wrote the words spelled correctly six consecutive times across two sessions. Target words were identified from students' written products during the intervention (e.g., written responses to CBM-W Picture Word, Writing activity).

The Alphabet Rocket activity was designed to improve students' handwriting skills at the sentence level. A sentence appeared at the top on a worksheet, and several lines were below the sentence for writing practice. The sentence included target letters corresponding to letters covered in the Alphabet Practice activity. The instructor read the sentence and had students read the sentence again. Then, students were asked to write the sentence as many times as possible for 3 min with fluency and accuracy.

The Writing activity was designed to provide an opportunity for students to be able to apply handwriting and spelling skills they acquired by completing a narrative story. The instructor read a starting prompt and discussed about the topic with students to activate their background knowledge and personal experience. Students wrote a story about the prompt and were encouraged to use the words that they learned so far in other writing activities. The writing prompts were related to a personal narrative or a story (e.g., one night I had a strange dream about…, it was the last day of school so I decided to…, etc.). After students completed writing a story, they read the story to the instructor. The instructor praised them for correctly spelled words that students were working on and provided corrective feedback on misspelled words.

The Word Sort activity was designed to categorize words by particular features to find general patterns about the spelling of words. The activity started with a teacher-directed approach, and the role of the teacher was faded gradually and led to a student-directed sort activity. General procedures were adapted from the CASL manual of handwriting and spelling program (Graham & Harris, 1999), and specific procedures and wordings were adapted from *Words Their Way* (Bear, Invernizzi, Templeton, & Johnston, 2012). In the teacher-directed sort, three steps were involved: demonstration, sort and check, and reflection. First, the instructor demonstrated how to categorize words by target features of the words through explicit modeling (*demonstration*). The instructor pronounced two or three master words that served as the very first words by emphasizing the target feature. For example, if the master word was ‘man’ and the target feature of the word was a short /*a*/ sound in the middle, the instructor said “This word is *man*. /m/-/a/-/n/. Man.” The instructor repeated the process for the other two master words. Students were asked to discuss similarities and differences in sounds and letters among the master words. The instructor helped students find the target features in letters or sounds. Then, the instructor showed students an additional word, pronounced the word, and placed the word under an appropriate category while explaining the reason to put the word. After completing two or three additional words and if students had a basic idea of how to sort words, students were asked to help the instructor place the rest of words. Students pronounced each word, placed the word under an appropriate category, and provided a rationale for putting the word under the category of master word with support from the instructor. If students put the word under an inappropriate category, the instructor corrected it immediately. Second, the instructor modeled how to check whether the words were sorted correctly by reading down words in each column (*sort and check*). Students could listen to hear the target sound or look for the pattern of the sound. Third, after every word was sorted, students stated a rule for the patterns observed (*reflection*). The instructor was encouraged to avoid telling the rule for the patterns directly, but rather to help students generate the rule using their own words. In the student-directed approach, the words were shuffled and, students were asked to sort the words by placing them in the appropriate category. If time permitted, students sorted additional words using the same procedures they used.

DBI Steps

DBI consisted of eight steps (Deno & Mirkin, 1977; McMaster et al., 2014).

Step 1 was "establish present level of writing performance (baseline) using CBM." An appropriate type of CBM-W task (either Word Dictation or Picture Word) was determined for monitoring students' progress for each student by considering their current level of writing skills. If students could write whole words but could not generate sentences, Word Dictation was selected. If students could generate sentences containing core basic elements of sentences such as capitalization and punctuation, Picture Word was chosen. Three alternate forms of CBM-W task were administered to establish a baseline and scored using either CLS (for Word Dictation) or CWS (for Picture Word). A median score was chosen as a fist data point and plotted on a graph, representing a baseline. For example, if a student got 3, 12, and 9 CWS for Picture Word prompts, the median of 9 CWS was plotted on the graph.

Step 2 was "set an ambitious long-term goal." To determine an attainable yet ambitious long-term goal, the total number of weeks in the intervention period was multiplied by the rate of weekly writing growth for typically developing students, and the baseline score was added to this product. Tutors chose between 0.5 to 1.0 CWS for Picture Word and between 1.0 to 2.0 CLS for Word Dictation as a rate of growth. These options were identified based on previous CBM-W research (McMaster et al., 2009; McMaster, Du, et al., 2011). The rate of weekly growth was determined by tutors' judgment on students' writing performance based on writing samples of CBM-W from screening. If they were unsure how to determine the rate of growth, the lowest rate was selected as an initial rate for each type of tasks. For example, 1.0 CLS for Word Dictations and 0.5 CWS for Picture Word were chosen as a rate of weekly growth respectively. If the median was 9 CWS, total intervention was 12 weeks and 0.5 CWS was chosen for Picture Word, the long-term goal was calculated as 9 CWS (baseline) + (0.5 CWS * 12 weeks) = 15 CWS. The long-term goal was plotted on the graph, and a goal line was drawn by connecting the baseline and the long-term goal. The CBM-W graph including the all dimensions is presented in Figure 1.

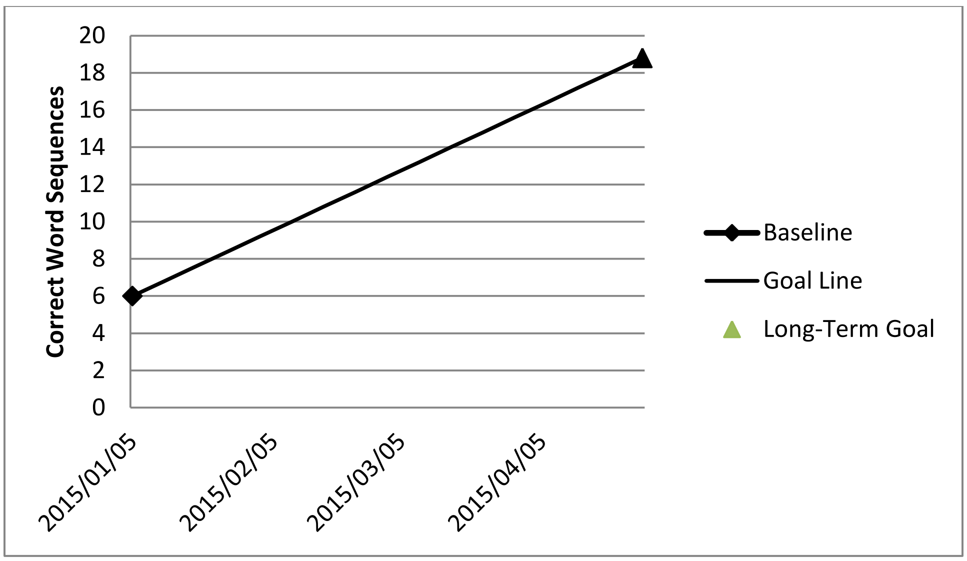

Figure 1. Curriculum-based measures in writing graph. Adapted from “Data-based instruction in beginning writing: A manual,” by K. L. McMaster, E. Lembke, D. Brandes, C. Garman, K. Moore, P. Jung, and B. Janda, 2014, Unpublished manual, Department of Educational Psychology, University of Minnesota, Minneapolis, U.S.

Step 3 was “implement high quality instruction with fidelity based on student needs.” The early writing intervention in this study consisted of instructional activities supported by scientifically conducted research. Tutors were required to implement the early writing intervention with fidelity of 80% at least for 30 min per session, three times per week during 12 weeks. Implementing research-based intervention with adequate fidelity is important for determining the adequacy of students' progress. If the effects of writing intervention are not supported by empirical research or if the writing intervention was not delivered with adequate fidelity, the insufficient progress of students might be because of the low quality of writing intervention or the low quality of delivering the writing intervention, rather than because of students' needs for intensifying intervention.

Step 4 was "monitor student progress toward the goal." Along with the implementation of research-based early writing intervention with fidelity, ongoing progress monitoring was conducted using CBM-W (via either Picture Word or Word Dictation). DBI tutors administered CBM-W twice weekly, scored the writing samples using four different scoring procedures (WW, WSC, CWS, and CIWS for Picture Word and WW, WSC, CLS, and CILS for Word Dictation), and plotted the scores on graphs. After collecting eight data points and plotting them on the graphs, a trend line -- which represents a trend of a student's rate of growth -- was added using a Microsoft excel software template. Eight data points were determined for drawing the initial trend line as it has been identified in previous research as the minimum number of scores to get a reliable slope (McMaster, Du, et al., 2011).

Step 5 was "use decision rules to evaluate student progress and instructional effectiveness." For making instructional decisions, tutors mainly examined a graph depicting scores scored by CWS for Picture word and CLS for Word Dictation. They were suggested to examine graphs scored by other scoring procedures if the decision based on the CWS graph was not clear. A series of decision rules used in literature (e.g., Fuchs et al., 1984) were applied to evaluate students' response and the effectiveness of the current intervention. Tutors examined the trend line and made an instructional decision by comparing the trend line with a goal line. If the trend line matched the goal line, the intervention was kept as is. If the trend line was steeper than the goal line, tutors were required to increase the goal as the current intervention was effective enough for the students. The goal was increased by setting a new goal using the median of the three most recent CBM-W scores (McMaster et al., 2014). If the trend line was less steep than the goal line, a change in intervention was warranted as the current intervention was not sufficiently effective to help the student meet his/her goal. The decision rules were applied again after getting at least four additional CBM-W scores.

Step 6 was "generate hypotheses to individualize instruction." If students did not show sufficient progress and the trend line indicated an instructional change was warranted, tutors generated hypotheses to individualize the instruction to meet the student's unique instructional needs. DBI tutors synthesized information from students' CBM writing samples, observation notes, and their judgment of students' writing needs. With the synthesized information, tutors made systematic changes to their intervention based on Data-Based Decision Making (DBDM) rubric. A series of steps and questions in the DBDM rubric guided tutors to consider possible reasons for the insufficient progress and choose appropriate options to change the instruction in a systematic way. A maximum of three components in the DBDM rubric could be applied for an instructional change. Tutors continued implementing the new intervention with fidelity until the next instructional change was required. The DBDM rubric is presented in Appendix H.

Step 7 was “make instructional changes based on hypotheses.” With the generated hypothesis and instructional options to change intervention suggested in the DBDM rubric, tutors recorded the Change in Instructional Plan (CIP) form for individual students. The CIP consisted of series of questions corresponding to each step in the DBDM rubric, leading tutors to design and plan the intervention by reflecting the options for the instructional changes (see Appendix I for CIP form).

Step 8 was “repeat steps 4 through 7.” Given that DBI is an ongoing process, students’ writing progress was monitored twice weekly (Step 4) and instructional changes were warranted if needed by applying data-based decision rules (Step 5). Tutors generated possible hypotheses based on collected information from various resources, selected options for instructional changes in the DBDM rubric (Step 6), and designed new instruction, documenting changes on the CIP form (Step 7).

Data-Based Decision Making (DBDM) Rubric

The DBDM rubric provided directions to tutors for choosing instructional changes. The rubric was developed by adapting concepts from resources regarding how to intensify academic intervention in reading and mathematics proposed by the National Center on Intensive Intervention (NCII, www.intensiveintervention.org). In the rubric, sequential steps for data-based decision making exist: applying data-based decision rules, checking fidelity of the intervention, and selecting instructional options.

After applying data-based decision rules, if tutors needed to change their current intervention, they asked themselves to check fidelity of the intervention by answering several questions about whether they implemented the intervention with fidelity by meeting a criterion of 80% and whether the intervention was delivered with intended dosages. If they answered all self-check questions as "Yes" and if they were satisfied with the fidelity of the intervention, types of changes necessary for individual students were considered. There were three categories for types of changes: changes to setting and format, changes to delivery, and changes to content.

"*Changes to Setting and Format*" involved changing the setting of the learning environment or format of the intervention activities while keeping the delivery methods and the content the same as the original intervention. The instructional options included changes of intervention dosage (frequency and duration), motivational strategies related to students' behaviors, and intensifying individualized interaction with students. For example, tutors could spend time with a student individually before or after the intervention or while having other students do their own work in a small group. "*Changes to Delivery*" was to modify the delivery of the intervention by making the intervention more explicit and systematic while keeping the content the same as the current intervention. For "*Changes to Content*," tutors could change the order of units containing different target letters/words or select different content to align better with student needs reflected on students' writing samples as needed. Specific instructional options for each type of changes in the DBDM rubric were listed in Appendix H.

If tutors were able to find appropriate instructional options in the DBDM rubric, they selected one of them. If they were not sure which options would be appropriate for changing the instruction, they considered whether to change setting and format, delivery of the intervention, or content of the intervention, in that order. The guidelines for choosing types of changes were determined by considering the time and effort necessary to make changes. The earlier options were easier and less time consuming than the later ones.

Control Condition

In order to examine the unique benefits of DBI beyond writing instruction in classroom for improving students' early writing performance, features of writing instruction and writing assessment provided to control students were captured through direct classroom observations and email/phone communications with teachers. Classroom observations were conducted by five people including an associate professor in special education, a research associate with a master's degree in special education, two doctoral students in special education, and one doctoral student in school psychology. A classroom observation sheet was adapted and modified from Coker and Ritchey (2010) to capture the overall characteristics of writing instruction in terms of type of grouping (whole class, large group, small group, pair, and individual), management of instruction (teacher-managed, student-managed, and technology managed), writing focus (transcription, text generation, and self-regulation), levels of writing (letters, words, and sentences) and type of teacher and student responses during each activity (*Classroom observation sheet* is in Appendix J).

Writing instruction was delivered by four special education teachers and three general education teachers. In general, the writing instruction varied by teachers and levels of writing, at word-, sentence-, or discourse-level. Most writing instruction focused on word- and sentence-level writing. At word-level writing, students read words, copied the words, and found pictures corresponding to the words, or vice versa by looking at the pictures, finding letters, and reading the whole word. At sentence-level writing, students matched beginnings and endings of sentences to make sense. In other cases, students read a story, made a prediction, drew pictures associated with the prediction, and wrote sentences corresponding to the pictures. Teachers provided guided feedback on the words that students were struggling by showing the words presented in the story. Sometimes, after generating sentences, teachers provided specific feedback on grammar or sentence formation including capitalization, spacing, punctuation, and tense, and students shared what they wrote to other students in a small group. At discourse-level writing, students were asked to make a diorama by drawing and sketching a draft of the diorama. After showing a model, teachers circulated and provided directions and guidance, and reinforced students to follow the directions by making a list of things to include in their diorama.

The nature of writing assessments was explored via email/phone communications with teachers. General education teachers reported that they rarely conducted progress monitoring in writing for students. Rather, they kept students' writing samples during the semester and sent the writing samples home at the end of semester. Special education teachers did progress monitoring in writing officially or unofficially. Depending on writing objectives in the individualized education program (IEP), students' writing performance was measured by CBM-W Story prompts once per week, once every 2 weeks, or once per month. One special education teacher reported that she made her own way to keep track of students' writing performance by counting the number of words written, number of sentences written, or number of different words used in daily writing samples.

Procedures

Training of Data Collectors

Data for screening and pre- and post-testing were collected by six data collectors. The data collectors included five doctoral students who were majoring in special education (*n* = 3), school psychology (*n* = 1), and curriculum and instruction (*n* = 1), and one master's student pursuing special education teacher licensure. All data collectors had experience working on large-scale school-based research, and teaching or working with students in elementary schools. Administration training of screening and pre- and post-measures (CBM-W Picture Word prompts and the three WJ III subtests) was provided to the data collectors by the principal investigator for one hour. For CBM-W Picture Word prompts, testing materials were distributed including administration directions, student copy, administrator copy, and a timer. The principal investigator demonstrated the administration procedures using the testing materials. The data collectors were paired and practiced with their partners. For the WJ III, the purpose and general procedures of each subtest were introduced. Then, unique administration features of each subtest were emphasized such as identifying basal and ceiling, different start-and-end points by grade levels, and grouping of students. Before the data collection started, the principal investigator checked the fidelity of administration of CBM-W Picture Word by using the first part of the AIRS. Administration of the WJ III was checked by asking prepared questions associated with essential administration components. If the answers of the data collectors were incorrect, corrective feedback was provided immediately. The data collectors were asked to audio-record their administration of CBM-W and the WJ III. Administration fidelity was 100% for both measures.

Screening

Forty-nine consented students were administered three alternate forms of CBM-W Picture Word prompts by six trained data collectors. Picture Word prompts were administered individually or in a small group of two students. Individual testing was performed if only one student was available or if the classroom teachers recommended one-on-one administration. Three alternate forms were administered consecutively within a session to save time and to acquire more stable scores (Hosp et al., 2006).

The screening process to identify eligible student participants was conducted in two phases. First, students' writing samples from Picture Word prompts were scored using CWS. Students whose median score was below 15 CWS were identified (n = 41). Second, of those students whose median score was above 15 CWS, students whose standard score on the WJ III Spelling subtest was below 1 standard deviation of the mean (n = 5) were included. In addition, students who generated sentences using the same simple structure on Picture Word prompts were included (e.g., "I have a dog," "I have a lamp," "I have a shoe"). The use of Spelling subtest scores and sentence structure were used as additional screening criteria in order to not drop any students who might benefit from this study. Through these procedures, a total of 48 students were identified as eligible students.

Pre and Post Assessment

Three alternate forms of CBM-W Picture Word and the three WJ III subtests were administered to all students during two weeks immediately before (in January) and two weeks after implementing DBI (in May). The measures were used as pre-and posttest measures to examine mean differences between treatment and control students. Picture Word prompts and the WJ III Writing Fluency and Writing Samples subtests were administered by trained research staff individually or in a small group of two. The WJ III Spelling subtest was administered individually. When the dependent measures were administered in a small group of two, administrators used a standing folder as a barrier to prevent students from distracting each other.

Progress Monitoring to Control Condition

Given that students in the treatment condition were exposed to CBM-W Picture Word frequently (twice per week) during the 12 intervention weeks, students in control condition also were administered Picture Word prompts two times during the study period in order to address the possibility of practice effects of progress monitoring measured by CBM-W.

Scoring Procedures

Five doctoral students including the principal investigator served as scorers for CBM-W Picture Word and the three WJ III subtests (Spelling, Writing Fluency, and Writing Samples) at pre- and post-test. Four doctoral students were in special education and one was in the school psychology program.

All scorers had an intensive scoring experience of CBM-W through their involvement in a federally-funded project before they were involved in this study. In the federally-funded project, the scorers received CBM-W scoring training for approximately one hour. First, they scored a set of common CBM-W Picture Word prompts together, applying the four scoring procedures (WW, WSC, CWS, and CIWS). They compared their scores, and discussed discrepancies. Then, a package of students' writing Picture Word samples was distributed to each scorer and the scorers completed scoring individually. The scores of the completed package were compared with scores by an "expert" scorer. The "expert" scorer had to meet reliability criterion of 90% with a principal investigator of the federal funded project, an associate professor in special education program who had extensive scoring experience. Once each scorer reached a scoring reliability criterion of 80% with the "expert" scorer, additional students' writing samples were assigned to the scorers. While the scorers independently scored, they discussed scoring issues that occurred and resolved them in a weekly group meeting or individual meeting.

For this study, the CBM-W Picture Word scorers received an additional one-hour training session to refresh their memory of the scoring procedures (WW, WSC, CWS, and CIWS) that they learned as part of the larger project described above. After the training, students' writing responses to Picture Word prompts were assigned to each scorer. The principal investigator compared 20% of each scorer's scored writing samples with her own and calculated the inter-rater agreement. The agreements and disagreements were counted using a point-by-point method applied in previous research (McMaster et al., 2009; McMaster, Du, et al., 2011). The percentage of inter-rater agreement was calculated as the number of agreements divided by the number of agreements plus disagreements and multiplied by 100. The inter-rater agreement checking process was repeated until they met the criterion of 80% of scoring reliability. If the inter-rater agreement was below 80% on any scoring procedure, additional training was provided to the scorer. The inter-rater agreement on scoring procedures ranged from 91.43% to 100% for all scoring procedures.

The WJ III Spelling subtest was scored by the principal investigator. Each item was scored as 0 for incorrectly spelled letter(s) or word(s) and 1 for correctly spelled ones based on answer keys in the manual (Mather & Woodcock, 2001). Twenty percent of Spelling scored completely was checked by another scorer. The inter-rater agreement was 100%.

To score the WJ III Writing Fluency and Writing Samples, a one-hour training session was provided to a doctoral student in special education. The principal investigator described overall testing procedures, testing materials, and scoring criteria for both subtests. For Writing Fluency, the scorer had to make sure to score all sentences that students generated (in case students skipped several items) and marked to indicate the last sentence. Each sentence was scored as 1 if it met the three criteria; the sentence should be a complete sentence, include three words given, and make sense. Each sentence was scored as 0 if the sentence did not meet one of the three criteria. The scorer wrote the final score and circled the final score with her initial. For the Writing Samples subtest, specific scoring criteria for each item were provided in the manual (Mather & Woodcock, 2001). Items were scored from 0 to 2 depending on the extent to which each response met the criteria. The scorer wrote a score for each item on the side and summed up the scores to get a final score. She marked the final item, and wrote the final score with her initial.

During scoring training, two scorers including the principal investigator practiced scoring students' writing responses to the WJ III Writing Fluency and Writing Samples, compared their scores, and discussed specific scoring criteria for items on which the two scorers were discrepant. After practicing and getting consensus on scoring criteria, the two scorers scored 20% of students' writing responses independently, and compared their scores. Inter-rater agreement was calculated as the number of agreements divided by number of agreements plus disagreements multiplied by 100. If the scorer met an 80% of scoring reliability, additional writing samples were assigned. If not, the principal investigator had an individual meeting and discussed items scored differently from the key scores. To ensure 80% inter-rater agreement throughout the writing samples, the principal investigator checked 20% of all writing samples scored by the second scorer. On average, the inter-rater agreement was 100% for Writing Fluency and 90.29% for Writing Samples (ranged from 85.74% to 92.86%).

Tutor Training

Two 2-hour workshops and one 1-hour workshop were held to train tutors. Before the first workshop, readings and power point slides were distributed to tutors in order to provide the overview of DBI.

The purpose of the first workshop was to provide tutors with a general idea of the early writing intervention and have them become comfortable with instructional materials and procedures so that they could practice on their own after the workshop. Each DBI tutor received one tutor binder and four student binders. The tutor binder contained all instructional materials necessary for tutors (cards and worksheets, intervention planning sheet, intervention log, progress track logs, point sheet, and stickers), and the student binder contained student worksheets. An intervention planning sheet was provided to support tutors to schedule before the intervention started and to consider make-up plans for anticipated missed days. An intervention log was included to record students' attendance and observation notes for each session of the intervention. A progress track log was included to track students' academic progress. DBI tutors were requested to document units and lessons they covered, and keep track of target letters and words students learned. Intervention planning sheet, intervention log, and progress track logs are in Appendix K. A point sheet was provided for each tutor and students to set a goal for the day as a motivational component. The tutors received stickers to use as reinforcement.

The principal investigator described the overall structure of the early writing intervention in terms of units, lessons, and required dosage. She explained the purpose of each writing activity, showed instructional materials, described general procedures, and demonstrated for each writing activity: Phonics Warm-up, Alphabet Practice, Word Building, Word Study, Alphabet Rockets, and Word Sort. After the demonstration, tutors had time to practice the activity with their partner and asked questions. Tips for successful implementation of the intervention and behavior management skills were also provided.

The second workshop covered administration, scoring, and graphing of CBM-W prompts. The purpose of the second workshop was to provide background knowledge of CBM to tutors, and get them skills for administering, scoring, and graphing CBM-W. Tutors learned administration procedures of the two types of CBM-W used as progress monitoring measures: Picture Word and Word Dictation. Administration directions and CBM-W prompts (student copy) were distributed to tutors. The principal investigator demonstrated administration procedures by acting as an administrator while tutors acted as students. For scoring, a definition of each scoring procedure was introduced (WW and WSC for both measures, CWS and CIWS for Picture Word, and CLS and CILS for Word Dictation). Each scoring procedure was demonstrated to tutors and then, tutors were asked to practice using several sample items together. For graphing, an excel document programmed to plot CBM-W scores was distributed and saved on each tutor's laptop. Graphing procedures (identifying baseline data, setting a long term goal, selecting a weekly rate of growth, and drawing a goal line) were introduced and demonstrated. DBI tutors practiced creating their own graphs on the laptop and asked questions about unclear steps or procedures. A complete ideal CBM-W graph was shown as an example to help tutors understand what the graph would look like and what the graph was for.

The third workshop was held to provide an overview of the study and to explain DBI steps to tutors. A brief overview of the study emphasizing specific research questions and study design was reviewed, and each step of DBI was introduced. Tutors were guided to use CWS or CLS scores on a graph as a primary scoring procedure for making instructional decision (CWS for Picture Word, and CLS for Word Dictation).

They were encouraged to use other scoring procedures (WW, WSC, or CIWS for Picture Word and WW, WSC, or CILS for Word Dictation) if they had hard time to decide based on the primary scoring procedure. The principal investigator explained the decision-making rules, which is a part of the DBI steps, and gave practice time to apply the rules. Specific data-based decision rules for CBM-W graphs were also introduced. The specific rules included as follows: applying data-based decision rules after getting at least eight data points for the initial time, and applying the rules after four points for the following time. The principal investigator explained how to use the data-based decision making (DBDM) rubric if the instructional changes were needed.

Instructional Procedures

Forty-eight students who met the eligibility criteria were identified and assigned randomly within classrooms to either treatment (DBI) or control conditions. Students in the treatment condition received DBI instead of regular classroom writing instruction three times per week, for 30 min per day, over 12 weeks. DBI was delivered by six trained tutors in small groups of four students in designated quite spaces. The principal investigator and classroom teachers made sure that the students in the treatment condition did not miss any core school curriculum and special services they should have received. Students in the control condition received business as usual writing instruction in their classrooms or resource rooms by their classroom teachers or special education teachers.

Inter-Rater Scoring Reliability of Progress Monitoring

To ensure scoring reliability of each tutor’s scoring, CBM-W prompts scored by each tutor were compared to scores done by the principal investigator. The scores by the principal investigator were used as scoring keys after reaching an inter-rater agreement above 90% with an associate professor in special education who was an expert in scoring CBM-W. The inter-rater scoring reliability between tutors and the principal investigator ranged from 90.60% to 92.66% for Picture Word and from 98.67% to 100% for Word Dictation.

Fidelity of Implementation Procedures

Fidelity of implementing DBI was conducted in two phases for checking DBI steps and early writing intervention. The fidelity checks were conducted in March and April, four and eight weeks after DBI began. The time points were determined in order to check the extent to which DBI implemented accurately before and after any initial instructional changes were made. DBI tutors were required to change their intervention after getting at least eight data points, which were needed for a reliable CBM-W slope (McMaster, Du, et al., 2011). Thus, it was important to check the fidelity of implementation before and after they made an instructional change (noted as Fidelity 1 and Fidelity 2). The AIRS and Writing Intervention Checklists were used for checking DBI steps and the early writing intervention respectively.

Every tutor was requested to audio-record the administration of CBM-W Picture Word or Word Dictation (whichever was applicable for their students) and their tutoring sessions comprising all different writing activities. The audio files were saved in a secured folder where only the principal investigator was able to access with a password. Additional materials including CBM-W graphs for each student, CBM-W prompts scored, and Change Instructional Plan (CIP) were collected from tutors to check fidelity of DBI steps.

Fidelity of DBI steps was checked using the AIRS, which comprised of five parts to check (a) administering CBM-W, (b) scoring CBM-W, (c) graphing CBM-W, (d) applying the data-based decision rules, and (e) overall implementation of the early writing intervention. For checking administration of CBM-W, audio files were played and marked either 1 (if observed) or 0 (if not observed) on the AIRS. For checking scoring CBM-W, writing prompts scored by each tutor were examined and compared with scoring keys made by the principal investigator. The scored CBM-W was evaluated as to whether each tutor followed the scoring guidelines.

For checking graphing CBM-W, graphs for each student assigned to each tutor were collected and examined in terms of containing essential components, including establishing a baseline and long-term goal, and drawing a goal line. In order to check whether tutors applied the data-based decision rules appropriately, CBM-W graphs and CIPs were examined. A student's trend line compared to a goal line was examined and checked whether tutors made instructional decisions at appropriate time points by applying the data-based decision rules. For example, tutors had to make an instructional decision after gathering eight data points. CIPs were examined to ensure whether tutors made appropriate instructional decisions at time points corresponding to the days that they indicated in the CBM-W graphs. The rationale for making the instructional decision, type of instructional decisions, and types of instructional changes that tutors chose (if needed) were checked based on CIPs. The fidelity of the overall implementation of the early writing intervention was checked by skimming the audio files recorded all writing activities for each tutor.

In order to examine the fidelity of DBI steps, two raters discussed rating criteria for each item in the AIRS regarding the five parts addressed above: administration, scoring, and graphing CBM-W, application of data-based decision rules, and overall procedures of early writing intervention. The two raters rated each part of the AIRS by marking 1 (if observed) or 0 (if not observed) using necessary materials: CBM-W administration audio files, CBM-W prompts completely scored by tutors, CBM-W graphs, CIPs, and writing intervention audio files. They compared the rating outcomes and discussed on items showing discrepancies to obtain sufficient inter-rater agreement of 80%. After reaching a criterion of 80%, the two raters checked the fidelity independently. Percent inter-rater agreement was calculated as the number of agreements divided by the number of agreements plus disagreements and multiplied by 100. The inter-rater agreement was 99.33%. The average fidelity of DBI steps was 95.68% at Fidelity 1 (range = 90.90% to 100%) and 95.67% at Fidelity 2 (range = 82.86% to 100%).

Fidelity of early writing intervention was checked by listening to audio files of all writing activities. The fidelity was examined by checking 1 (if observed) or 0 (if not observed) using the Writing Intervention Checklists. The procedures for checking the fidelity of early writing intervention was the same as for checking DBI steps. The two raters discussed rating criteria for each item in the Writing Intervention Checklists. They discussed and resolved discrepancies if the inter-rater agreement was below 80%. They continued the process until they reached a criterion of 80% before they started checking the fidelity independently. The inter-rater agreement was 98.56%. The average fidelity of early writing intervention was 93.62 % at Fidelity 1 (range = 88.89% to 100%) and 98.66% at Fidelity 2 (range = 83.33% to 95.24%).

Interventional Adjustments

DBI tutors were asked to make instructional decisions using data-based decision rules, draw a vertical line to indicate the instructional changes on CBM-W graphs, and documented the changes in CIPs. *Total number of instructional decisions* was defined as the total number of instructional decisions tutors made using data-based decision rules during the study period. The information was derived from CBM-W graphs and CIPs. *Number of goal increases* was counted when tutors set a new long-term goal and documented the changes if a trend line was steeper than a goal line. *Level of goal ambitiousness* was calculated for each student by subtracting the initial writing performance (baseline) from the final long-term goal. *Number of instructional adjustments* was counted based on CBM-W graphs and CIPs which tutors documented if a trend line was less steep than a goal line. *Nature of instructional adjustments* was coded for three types of instructional changes listed in the DBDM rubric: "Changes to Setting and Format," "Changes to Delivery," and "Changes to Content."

CIPs provided the relevant information of the nature of instructional adjustments by asking tutors to document the type of instructional changes. Two doctoral students in special education examined the intervention adjustments for each category. The percentage of agreement between two raters was calculated by number of agreements divided by the number of agreements plus disagreements and multiplied by 100. The agreement was 100% between the two raters.

Specific instructional adjustment information including the number of times of instructional adjustments for each student along with percent is summarized in Table 7. Tutors made 47 instructional decisions in total across students, and about 2.14 times on average per student (range = 0 to 4). In terms of three instructional options (e.g., goal increases, keep the intervention as is, and instructional adjustments), tutors made 19 “goal increases” in total (40.43%), 5 decisions to “keep the intervention as is” (10.64%), and 23 “instructional adjustments” (48.94%). For the type of instructional adjustments, tutors made 11 “changes to setting and format” (47.83%), 8 “changes to delivery” (34.78%), and 4 “changes to content” (17.39%). Table 7 includes a summary of frequency of instructional decisions in terms of the number and percentage of students corresponding to the number of times. For example, tutors made goal increases zero times for seven students (31.81%), one time for 11 students (50%), and two times for four students (18.18%). The average level of goal ambitiousness was 18.66 CWS (range = 6.3 to 36.5) for CBM-W Picture-Word tasks and 17.83 CLS (range = 10.5 to 28.4) for Word Dictation tasks.

Table 7

Summary of Frequency of Instructional Decisions

Number of times	Goal increases	Keep the intervention as is	Instructional adjustments	Nature of instructional adjustment		
				Setting and format	Delivery	Content
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
0	7 (31.81)	-	6 (27.27)	13 (50.09)	14 (63.63)	18 (81.81)
1	11 (50)	5 (100)	10 (45.45)	7 (31.81)	8 (36.36)	4 (18.18)
2	4 (18.18)	-	5 (22.73)	2 (9.09)	0 (0)	0 (0)
3	-	-	1 (4.54)	-	-	-
4	-	-	-	-	-	-

Ongoing Support

DBI tutors received ongoing support in group and individual meetings throughout the study period. All tutors participated in a one-hour group meeting and 30-min individual meeting on a weekly basis. The group meeting was held to resolve issues that had arisen during the intervention and review students' progress monitoring data. The individual meeting was held to check whether each tutor kept track of students' progress and implemented DBI accurately and appropriately.

At group meetings, tutors asked questions to clarify how to implement each writing activity along with DBI steps and, shared issues while they implemented the intervention during the week. In addition, each tutor presented a graph of one student who was considered to be the most struggling in terms of writing performance, or for whom the tutor needed feedback from other tutors on instructional changes. The reviewing procedure was followed by a "DBI progress monitoring meeting: Note taking" agenda. The addenda was adapted from NCII resources (NCII, http://www.intensiveintervention.org/resource/progress-monitoring-meeting-tools-support-intensive-intervention-data-meetings) and modified to fit to this study (see Appendix L). Each tutor had a paired partner during the group discussion. One person took notes for the other tutor while the one reviewed and reported information about the target student, and then they switched roles. First, tutors reviewed the target student's progress monitoring data by examining the current trend line compared to the goal line. They also described possible factors affecting the implementation of the intervention during the week such as scheduling, attendance, resources, and behaviors. The possible factors provided additional background information to other tutors in terms of the student's current writing performance and learning environment beyond the information from the CBM-W graph. Tutors reviewed the effects of the previous instructional change and student's response to the new intervention reflecting those changes. If the trend line indicated a need to change the instruction, DBI tutors discussed what to change based on the DBDM rubric and planned for the next intervention.

At individual meetings, all intervention materials (intervention log, progress track log, CBM-W prompts scored, CBM-W graphs, and CIPs) were screened and checked. If a tutor missed a day of keeping track of students' progress or skipped steps of DBI (e.g., did not apply data-based decision rules after getting eight initial data points), they received corrective feedback and were asked to make up the missing components. DBI tutors could ask any questions involved in implementing early writing intervention, administrating, scoring, and graphing CBM-W, DBI steps, and relevant issues to their students. For example, they could ask about how to score specific writing samples and interpret tend lines in CBM-W graphs for a particular student in their group.

Data Analysis

To address the first research question regarding the differential effects of DBI for improving students' early writing performance depending on students' special education status and type of writing skills, a mixed two between-subjects factors and one within-subjects factor model of multivariate analyses of variance (MANOVA) was used for each dependent measure: CBM-W Picture Word and the WJ III writing subtests (Woodcock et al., 2001). Treatment condition (DBI vs. control) and special education status were used as between-subjects factors for both dependent measures. Type of scoring procedures (WW, WSC, CWS, and CIWS) and type of subtests (Spelling, Writing Fluency, and Writing Samples) were used as within-subjects factors for CBM-W and WJ III, respectively. For CBM-W, each type of scoring procedure was treated as measuring different aspects of the same construct, writing skills. Also, for the WJ III, each subtest was treated as measuring different aspects of writing skills. Thus, by treating type of scoring procedures and type of subtests as within-subjects factors, the mixed model of MANOVA allows examination of the main effects of the independent variables on the combined dependent variables along with interaction effects among them (Tabachnick & Fidell, 2007).

Significant multivariate results were followed up with univariate independent one-way analysis of variances (ANOVAs). If a significant interaction was found among independent variables (e.g., treatment condition, special education status, types of scoring procedures, or types of subtests), a separate independent *t*-test or one-way ANOVA was conducted to explore the effects of each independent variable on students' writing performance. To minimize the possibilities of making a Type II error (false negative) due to small sample size, all profile plots depicting the nature of interactions among the independent variables were examined. When profile plots indicated possible interactions, additional analyses were conducted to describe the nature of interaction. All analyses were performed using SPSS version 22.0.

Holm-Bonferroni adjustment, a less conservative but more powerful method than the Bonferroni adjustment, was used to detect significance for multiple univariate comparisons (Holm, 1979). The Holm-Bonferroni adjustment decreases the chance of Type I errors by considering controls for the chance of Type II errors. First, all observed *p*-values were ranked in order from smallest to largest. The first smallest *p*-value was compared to α/k ($\alpha = .05$, k = number of comparisons), and the next smallest *p*-value was compared to $\alpha/(k\text{-}1)$. The same procedure was continued until a *p*-value was determined as non-significant. The remaining *p*-values higher than the non-significant *p*-value are considered non-significant.

To estimate practical importance of the effects of DBI, effect sizes were calculated using Hedge's *g* (Hedges & Olkin, 1985). Hedge's *g* is the most commonly used effect size measure with a correction for small sample size (What Works Clearinghouse [WWC], 2011). Hedge's *g* is calculated as the mean difference between treatment and control conditions divided by the pooled within-group standard deviation. The formula is:

$$g = \frac{x_i - x_c}{\sqrt{\frac{(n_i - 1)s_i^2 + (n_c - 1)s_c^2}{n_i + n_c - 2}}}$$

The calculated effect sizes were interpreted by adapting Cohen's guidelines (1988). The rules of thumb for interpreting effect sizes proposed by Cohen are as follows: effect size of 0.20 is interpreted as small, 0.50 as medium, and 0.80 as large.

To address the second research question regarding the feasibility of DBI, descriptive information from feasibility survey were summarized in a table, and responses to open-ended questions were synthesized.

CHAPTER IV

RESULTS

The purpose of this study was to examine the effects of DBI for improving beginning writing performance of children identified as at risk or with disabilities that affect their writing skills depending on their special education status and type of writing skills. The feasibility of DBI was examined as a secondary purpose. Specific research questions were: (1) What are the effects of DBI on writing outcomes of students in Grades 1 to 3 at risk or identified with disabilities? Do the effects of DBI vary by (a) special education status and (b) type of writing skills as measured by CBM-W and a standardized writing measure? (2) To what extent is DBI feasible to implement with beginning writers? This study used a true experimental group design in which participants were assigned randomly within classrooms to treatment (DBI) or control conditions.

In the following sections, I report results of preliminary analyses. Then, I present descriptive data, results of the primary analyses, and responses to the feasibility survey.

Preliminary Analyses

Prior to running the main analyses, three preliminary procedures were conducted to examine: (1) the amount and pattern of missing data, (2) pre-treatment differences between groups, and (3) assumption checking for MANOVA.

Amount and Pattern of Missing Data

The whole data set was screened with attention to the amount and pattern of missing data. Given that the unit of assignment was the individual student, the unit of analysis was individual students. CBM-W scores of two students in the treatment condition were not obtained at post-test. One of these two students was also missing Woodcock-Johnson III Tests of Achievement (WJ III; Woodcock et al., 2001) scores. This student dropped out of the study after receiving the intervention for one week due to a conflict with the school core curriculum schedule (in parental consent forms, it was noted that students participating in the study would not miss any important core school curriculum). The other student was not able to complete CBM-W as he was absent on the day it was administered and was not available for make-ups. The amount of missing data is approximately 5% in a random pattern from the whole data set, indicating that proceeding with the analyses was appropriate (Tabachnick & Fidell, 2007).

To examine if the analyses were sensitive to the missing posttest data of the two students at pre-test, MANOVA was conducted with the students who were missing posttest data included and excluded for CBM-W and the WJ III separately. If the results of analyses were the same with the two students who were missing posttest data were included and excluded, then the analyses were not sensitive to the inclusion of the students. In contrast, different results would indicate the analyses were sensitive to the inclusion of the students who were missing posttest data and the two students should not be included in the final analyses.

A series of MANOVA were conducted with treatment condition and special education status as the between-subjects factors and type of scoring procedures (WW, WSC, CWS, and CIWS for CBM-W) and type of subtests (Spelling, Writing Fluency, and Writing Samples for the WJ III) as within-subjects factors. The MANOVA produced the same results with the two students who were missing posttest included and excluded for CBM-W. The results of analyses showed a significant main effect of scoring procedures, and no significant main effects of treatment condition and special education status. There were no significant two-way and three-way interactions among independent variables (all *p*s > .05). Table M1 in Appendix M contains the statistical results.

For the WJ III, the results of MANOVA were different with the two students included and excluded. With the two students included, significant main effects of special education status and type of subtests were found. An effect of treatment condition was not significant. No significant two-way and three-way interactions were found among independent variables. With the two students excluded, the statistical results were the same as when the students included in terms of the main effects. The interaction effects, however, were slightly different. No significant interaction effects were found except for the interaction between treatment condition and special education status ($F[1, 42] = 4.893$, $p = .032$). Table M2 in Appendix M contains the specific statistical results. The results indicate that the analyses were not sensitive to the inclusion of the missing data for CBM-W, but sensitive for the WJ III. Thus, the two students who were missing the posttest were excluded for the final analyses, and a total of 46 students' scores were used for the final analyses.

Pre-treatment Differences between Groups

Using scores of the total sample ($N = 46$), group mean differences were examined for all dependent variables at pre-test to establish comparability of baseline performance between groups. Statistically significant differences on pre-test scores should be taken into account and adjusted statistically to control for variance explained by potential confounding variables (Pressley, Goodchild, Fleet, Zajchowsk, & Evans, 1989). To examine possible pre-test differences between groups, MANOVAs were conducted for CBM-W and the WJ III with treatment condition and special education status as the between-subjects factors and type of scoring procedures (WW, WSC, CWS, and CIWS) and type of subtests (Spelling, Writing Fluency, and Writing Samples) as within-subjects factors.

Results of the MANOVA showed no statistically significant mean differences in terms of treatment condition and special education status for CBM-W ($F[1, 42] = 2.855$, $p = .099$; $F[1, 42] = 1.254$, $p = .269$ respectively). A significant mean difference was found for type of scoring procedures ($F[3, 40] = 71.024$, $p < .001$). There were no significant two-way and/or three-way interactions among independent variables. For the WJ III, no significant mean differences between conditions were found ($F[1, 42] = 2.17$, $p = .148$). Significant mean differences were found in terms of special education status ($F[1, 42] = 5.203$, $p = .028$) and type of subtests ($F[2, 41] = 50.337$, $p < .001$). One interaction effect was statistically significant, between treatment condition and special education status ($F[1, 42] = 4.893$, $p = .032$). Follow-up independent *t*-test showed statistically significant mean differences between conditions for students with disabilities ($t[25] = 2.703$, $p = .012$), but not for students without disabilities ($t[17] = -.534$, $p = .600$). See Figure M1 in Appendix M for the interaction plot between treatment condition and special education status.

Even though no statistically significant pre-test main effects were found for treatment condition for CBM-W and the WJ III, students in the treatment condition showed consistently higher means compared to those in the control condition. Hedge's *g*, calculated as the mean difference divided by the pooled *SD*s, were greater than 0.25, indicating the need for statistical adjustment (What Works Clearinghouse [WWC], 2011; see the ES column in Tables 8 and 9). Thus, a "regression adjustment," recommended by the WWC (2011), was conducted for all dependent variables measured by CBM-W and the WJ III.

A regression adjustment was conducted by building a regression model and using the standardized residuals as the dependent variables from the model for the final analyses. First, a regression model was built with pre-test scores as the independent variable and post-test scores as the dependent variable in SPSS version 22.0. Then, standardized residuals were automatically computed by the software. Residuals were computed by subtracting a student's actual score from the predicted score of the regression model, which removes variance accounting for pretest scores from posttest scores. Standardized residuals were derived from residuals that have been standardized by dividing a student's residual score by the standard deviation of all the residuals. In this approach, standardized residuals of all the dependent variables indicate scores after taking into account students' pre-test performance, and the scores are on the same scale with *M* of 0 and *SD* of 1.

Assumption Checking

Several assumptions relevant to MANOVA were checked for CBM-W and the WJ III subtests. The assumptions include multivariate normality, absence of univariate and multivariate outliers, homogeneity of variance, homogeneity of variance-covariance, linearity, and correlations among dependent variables (Tabachnick & Fidell, 2007).

Assumption checking for CBM-W. To examine multivariate normality, a Shapiro-Wilk test was completed. The results indicated that the sampling distributions of means of all dependent variables (CBM-W scores: WW, WSC, CWS, and CIWS) and linear combinations of each dependent variable were normally distributed across treatment and control conditions (all *p*s > .05, see Table M3 in Appendix M).

To examine univariate and multivariate outliers, box plots and Mahalanobis distance were examined. Box plots depicting CBM-W scores by type of scoring procedures indicated one outlier in the control condition (see Figure M2 in Appendix M). Because MANOVA is able to tolerate a few outliers (Tabachnick & Fidell, 2007), I proceeded with the analysis. To further examine multivariate outliers, Mahalanobis distance was calculated and compared against a critical chi-square value. The Mahalanobis distance of 11.99 was less than a critical value of 18.47. Given that no multivariate outliers were found (*p* >. 001), no outliers were removed for the final analyses.

Homogeneity of variance was examined via Levene's test. The results of Levene's test were non-significant for all dependent variables except for CWS. The *p*-values were .023 for WW, .017 for WSC, .007 for CWS, and .100 for CIWS. For CWS, the ratio of *SD*s between two conditions was less than 4:1 (1.19 *SD* for DBI and 0.58 *SD* for control condition). Thus, the homogeneity of variance assumption was not seriously violated (Wilcox, Charlin, & Thompson, 1986).

Homogeneity of variance-covariance was examined by Box's M test. Box's M indicated that variance-covariance was homogeneous for CBM-W scores across conditions (p = .039). If the Box's M test was significant at $p < .001$ and sample sizes were unequal across conditions, use of Pillai's criterion should be considered (Tabachnick & Fidell, 2007). Given the non-significant findings, Wilks' Lambda criterion was used for the final analyses.

To examine linearity, scatterplots presenting correlations of each dependent variable were used for treatment and control conditions. A series of scatter plots for CBM-W scores by type of scoring procedures (WW, WSC, CWS, and CIWS) showed linear relations among all pairs of dependent variables, indicating that the assumption of linearity was satisfied (see Figures M3 and M4 in Appendix M).

Finally, correlations among scores by four scoring procedures were explored by conducting Pearson's correlations among CBM-W scores at post-test. The correlations among CBM-W scores were high (r = .599 to .951, see Table M4 in Appendix M). In this study, the high correlations were expected because the four scoring procedures were based on the same writing sample. In addition, each score reflected different types of writing skills and provided meaningful information about students' writing. Thus, all dependent variables were retained for the analyses.

Assumption checking for the three WJ III subtests. The same assumptions examined above were checked for the WJ III subtests: Spelling, Writing Fluency, and Writing Samples.

For the assumption of multivariate normality, the Shapiro-Wilk test indicated that the multivariate normality assumption was satisfied across types of subtest and conditions except for the Spelling and Writing Fluency subtests in the control condition ($p < .05$, see Table M5 in Appendix M). MANOVA has been shown to be robust to the non-normality of data with a sample size of 40 ($n = 10$ per group; Seo, Kanda, & Fujikoshi, 1995). Given that the sample size in this study was over 40 ($n = 22$ and 24 for each condition), I proceeded with the analysis.

One to two univariate outliers were detected from box plots across conditions (Figure M5 in Appendix M). To examine if the analyses on writing performance measured by the WJ III were sensitive to the outliers, MANOVA was conducted with the outliers included and excluded with the treatment condition and special education status as between-subjects factors and type of subtests (Spelling, Writing Fluency, and Writing Samples) as a within-subjects factor. The results of analysis provided the same results for the outliers included and excluded. There was no significant main effect of treatment condition and type of subtests for the WJ III when the outliers were included and excluded. A significant effect of special education status was found. Students with disabilities showed lower performance than students without disabilities for both cases ($M = -.29$ and $M = .17$ when outliers excluded, $M = -.21$ and $M = .30$ when outliers included for students with disabilities and without disabilities respectively). All interactions were not statistically significant except for the interaction between special education status and treatment condition. According to the results of follow-up independent *t*-test, students with disabilities showed statistically significant mean differences between conditions, but not for students without disabilities. Tables M6 and M7 in Appendix M include the specific statistical results for MANOVA and the independent *t*-test respectively. The same results indicate the analyses were not sensitive to the presence of outliers. To maximize statistical power, outliers were not removed for the final analyses. The Mahalanobis distance of 10.3 was over the critical chi-square value ($p > .001$), indicating no multivariate outliers. Thus, no outlier was excluded for the final analyses.

The other assumptions including homogeneity of variance, homogeneity of variance-covariance, linearity, and correlations among dependent variables were satisfied. The results of Levene's test were non-significant for all three subtests of the WJ III ($p = .517$ for Spelling, $p = .994$ for Writing Fluency, and $p = .862$ for Writing Samples). The results indicate that differences in variances between conditions for each subtest were homogeneous. The Box's M test showed that variance-covariance was homogeneous ($p = .618$). For the assumption of linearity, most scatter plots of correlations among the three subtests showed linear or curvilinear trends across conditions (see Figures M6 and M7 in Appendix M). In general, Pearson's correlations among the three subtests were moderate (around $r = .30$ across conditions, see Table M8 in Appendix M), expected results given the three subtests were measuring different aspects of writing but the same construct of writing by being part of the Broad Written Language cluster in the WJ III.

Research Question 1

The first research question, “What are the effects of DBI on writing outcomes of students in Grades 1 to 3 at risk or identified with disabilities? Do the effects of DBI vary by (a) special education status and (b) type of writing skills as measured by CBM-W and a standardized writing measure?,” was addressed through the results of MANOVA. To further examine the practical strength of the effects of DBI, Hedge’s *g* was calculated. Descriptive statistics depending on students’ special education status are presented in Tables 8 and 9. The descriptive statistics include means, *SD*s, skewness, kurtosis, and effect sizes for each dependent variable at pre- and posttest. Descriptive information was based on raw scores of pre- and post-test, and standardized residuals were used for final analyses.

Table 8

Descriptive Statistics for CBM-W for Student Participants

	Students without disabilities					Students with disabilities				
	DBI (*n* = 9)		Control (*n* = 10)		*ES*	DBI (*n* = 14)		Control (*n* = 13)		*ES*
	Pre	Post	Pre	Post	Pre/Post	Pre	Post	Pre	Post	Pre/Post
CBM-W: WW					0.47/0.22					0.55/1.21
Mean	18.30	27.67	14.63	25.67		16.00	29.49	11.38	14.86	
SD	6.47	8.52	8.22	8.74		9.07	14.36	7.34	7.90	
Skewness	1.09	-0.34	-0.03	-0.84		0.94	-0.51	0.67	-0.09	
Kurtosis	1.77	-1.08	-0.41	-0.36		0.42	-0.22	-0.77	-0.24	
CBM-W: WSC										0.83/1.29
Mean	14.78	24.56	12.07	22.83	0.34/0.18	14.13	27.97	7.33	12.29	
SD	6.56	9.45	8.28	8.58		8.54	14.40	7.31	8.16	
Skewness	1.47	-0.27	0.29	-0.54		0.98	-0.44	0.86	0.22	
Kurtosis	3.29	-0.53	0.04	-1.08		1.32	-0.45	-0.43	-0.95	
CBM-W: CWS					0.11/0.36					0.76/1.36
Mean	10.48	21.52	9.60	17.13		10.72	25.92	5.26	8.29	
SD	8.19	14.12	7.62	8.82		7.62	15.87	6.36	7.64	
Skewness	1.91	0.13	0.51	0.01		0.73	-0.03	1.41	0.89	
Kurtosis	4.42	-0.45	-0.31	-0.91		-0.52	-0.96	0.89	0.23	
CBM-W: CIWS					0.28/0.33					0.90/1.37
Mean	-1.55	7.74	1.00	2.00		1.38	13.69	-6.29	-7.71	
SD	9.59	19.87	7.60	12.73		6.66	17.42	9.46	12.19	
Skewness	1.39	0.25	0.27	0.31		0.11	0.24	0.18	0.73	
Kurtosis	3.30	-0.45	-0.04	-1.02		-0.63	-0.81	-0.35	0.08	

Note. DBI = data-based instruction; CBM-W = curriculum-based measures in writing; WW = words written; WSC = words spelled correctly; CWS = correct words sequences; CIWS = correct minus incorrect words sequences; ES = effect size

Table 9

Descriptive Statistics for the WJ III for Student Participants

	Students without disabilities					Students with disabilities				
	DBI (*n* = 9)		Control (*n* = 10)		*ES*	DBI (*n* = 14)		Control (*n* = 13)		*ES*
	Pre	Post	Pre	Post	Pre/Post	Pre	Post	Pre	Post	Pre/Post
WJ III: Spelling					0.23/0/21					1.14/1.26
Mean	443.22	458.89	447.40	456.30		443.20	451.46	419.00	422.00	
SD	21.04	9.37	13.15	13.41		16.82	18.27	23.45	26.73	
Skewness	-1.41	-0.92	0.54	0.70		-1.03	-1.91	0.47	0.09	
Kurtosis	2.45	0.72	-0.48	-0.28		1.04	4.80	0.61	-0.74	
WJ III: Writing Fluency					1.78/-0.60					0.92/0.94
Mean	466.67	468.33	447.40	475.30		466.10	470.23	461.1	462.00	
SD	5.68	7.38	13.15	13.41		6.91	10.39	2.77	5.86	
Skewness	0.48	0.31	0.54	-0.11		1.39	1.26	2.92	3.53	
Kurtosis	-0.99	-1.51	3.41	-1.17		1.00	1.22	9.05	12.81	
WJ III: Writing Samples					-0.24/-0.51					0.68/1.16
Mean	451.00	466.33	457.60	475.10		449.60	467.54	428.4	429.29	
SD	33.00	13.15	17.64	18.65		25.08	26.27	34.84	37.44	
Skewness	-2.75	0.19	-0.75	-1.25		-1.08	-1.74	-0.44	-0.29	
Kurtosis	7.87	2.50	1.63	2.80		0.88	3.70	-0.54	-0.88	

Note. DBI = data-based instruction; WJ III = Woodcock-Johnson III Test of Achievement; ES = effect size

Curriculum-Based Measures in Writing (CBM-W)

The MANOVA with treatment condition (DBI vs. control) and special education status as between-subjects factors and type of scoring procedures as the within-subjects factor was conducted to examine the effects of DBI on the four CBM-W scoring procedures: WW, WSC, CWS, and CIWS. The results were derived based on standardized residuals of post-test performance after taking pre-test performance into account. The MANOVA revealed a significant main effect of treatment condition, $F(1, 42) = 5.293$, $p = .026$, and $g = 0.76$. The effect size of 0.76 indicated a large effect of DBI regardless of special education status and type of scoring procedures. Figure 2, depicting estimated marginal means, shows that students in the treatment condition outperformed those in the control condition. The main effect of special education status was not statistically significant, $F(1, 42) = 0.097$, $p = .757$. The main effect of type of scoring procedures was not significant, $F(3, 40) = 0.02$, $p = 0.996$. There were no significant interactions of treatment condition by special education status ($F[1, 42] = 2.764$, $p = .104$), treatment condition by type of scoring procedures ($F[3, 40] = 1.37$, $p = .266$), special education status by type of scoring procedures ($F[3, 40] = 0.909$, $p = .445$), or treatment condition by type of scoring procedures depending on special education status ($F[3, 40] = 0.956$, $p = .423$). Table 10 includes a summary of the MANOVA results for CBM-W.

Table 10

Results of MANOVA on CBM-W

Effect	*SS*	*df*	*Wilks' Λ*	*F*	*p*
Between-Subjects					
Treatment	3.857	1	--	5.293	0.026
SPED	0.071	1	--	0.097	0.757
Treatment * SPED	2.014	1	--	2.764	0.104
Error	0.729	42			
Within-Subjects					
Scoring Type	--	3, 40	0.999	0.020	0.996
Scoring Type * Treatment	--	3, 40	0.907	1.370	0.266
Scoring Type * SPED	--	3, 40	0.936	0.909	0.445
Scoring Type * Treatment * SPED	--	3, 40	0.933	0.956	0.423

Note. SPED = special education status; SS = sums of squares; *Wilks' Λ* = Wilks' Lambda

Although interactions were not statistically significant, profile plots indicated a pattern of three-way interactions between treatment condition and type of scoring procedures, depending on students' special education status (see Figures 3 and 4). Students without disabilities who received DBI appeared to perform lower than those who received business as usual writing instruction on WW and WSC. The trend of writing performance was reversed on CWS and CIWS. Students who received DBI appeared to perform higher than those who received business as usual writing instruction. Small, negative effects of treatment were detected on WW and WSC, g = -0.20 for WW and g = -0.11 for WSC. Moderate, positive effects were detected on CWS and CIWS, g = 0.32 for CWS and g = 0.48 for CIWS. Students with disabilities in DBI condition appeared to perform higher across types of scoring procedures than those in the control condition. Effect sizes were large and positive for all scoring procedures, g = 1.05 for WW, 0.92 for WSC, 1.17 for CWS, and 1.16 for CIWS.

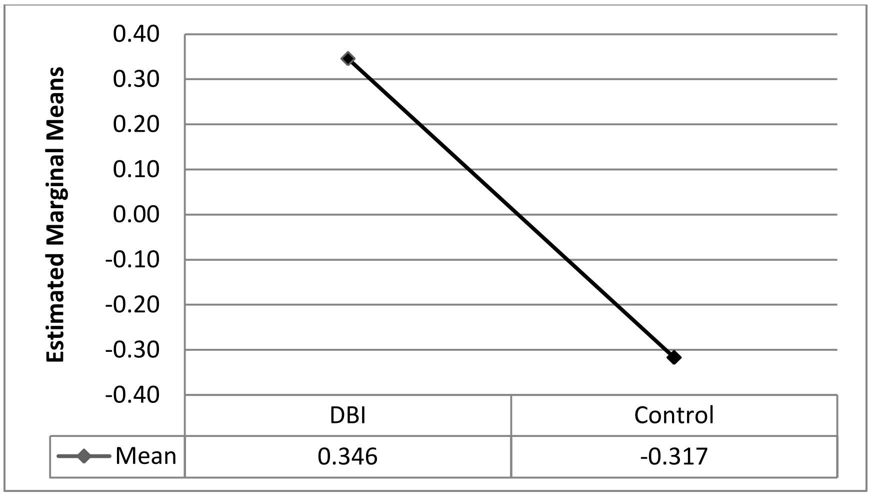

Figure 2. Estimated marginal means of CBM-W by treatment condition. DBI = data-based instruction.

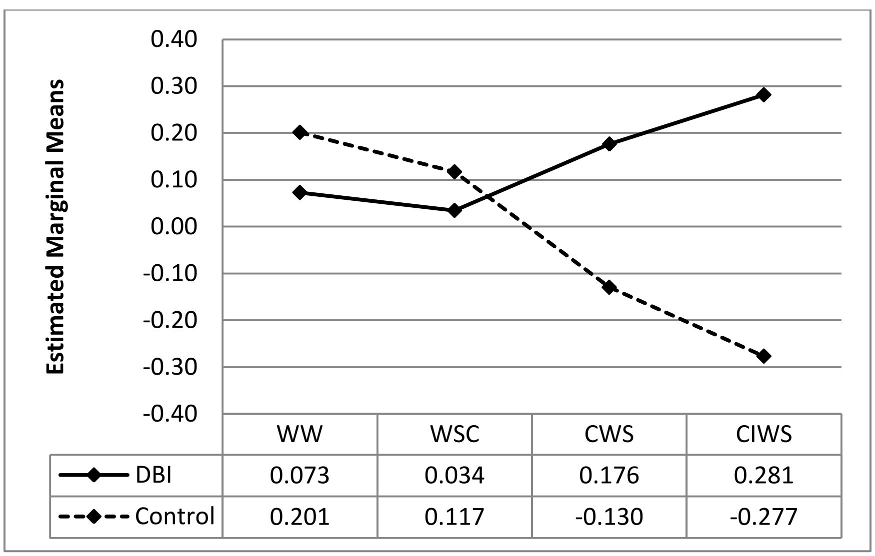

Figure 3. Estimated marginal means of CBM-W of treatment condition by type of scoring procedures for students without disabilities. DBI = data-based instruction; WW = words written; WSC = words spelled correctly; CWS = correct words sequences; CIWS = correct minus incorrect words sequences.

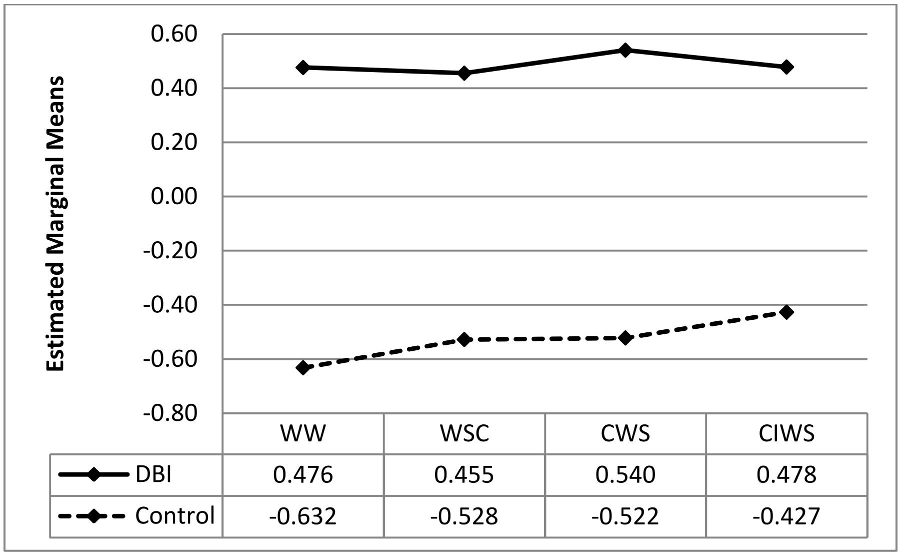

Figure 4. Estimated marginal means of CBM-W of treatment condition by type of scoring procedures for students with disabilities. CBM-W = curriculum-based measures in writing; DBI = data-based instruction; WW = words written; WSC = words spelled correctly; CWS = correct words sequences; CIWS = correct minus incorrect words sequences.

WJ III Subtests

A MANOVA with treatment condition (DBI vs. control) and special education as between-subjects factors and type of subtests (Spelling, Writing Fluency, and Writing Samples) as the within-subjects factor was conducted to examine whether there were statistically significant mean differences between conditions on the three WJ III subtests. The MANOVA revealed no statistically significant main effect of treatment condition, $F(1, 42) = 1.422$, $p = .24$. There was a significant main effect of special education status, $F(1, 42) = 8.162$, $p = .007$, $g = 0.89$. The effect size of 0.89 indicated a large effect for the effect of special education status regardless of treatment condition and type of subtests. Figure 5, which depicts estimated marginal means, shows that students without disabilities outperformed students with disabilities. The main effect of type of subtests were not statistically significant, $F(2, 41) = 0.018$, $p = .982$.

There was no significant interaction of treatment condition by type of subtests ($F[2, 41] = 2.696$, $p = .079$), special education status by type of subtests ($F[2, 41] = 0.179$, $p = .837$), or treatment condition by type of subtests by special education status ($F[2, 41] = 2.106$, $p = .135$). The interaction of treatment condition by special education status was statistically significant, $F(1, 42) = 6.487$, $p = .015$. Table 11 contains a summary of the MANOVA results for the WJ III.

Table 11

Results of MANOVA on the WJ III

Effect	*SS*	*df*	*Wilks' Λ*	*F*	*p*
Between-Subjects					
Treatment	0.483	1	--	1.422	0.240
SPED	2.773	1	--	8.162	0.007
Treatment * SPED	2.204	1	--	6.487	0.015
Error	14.271	42			
Within-Subjects					
Subtest Type	--	2, 41	0.999	0.018	0.982
Subtest Type * Treatment	--	2, 41	0.884	2.696	0.079
Subtest Type * SPED	--	2, 41	0.991	0.179	0.837
Subtest Type * Treatment * SPED	--	2, 41	0.907	2.106	0.135

Note. SPED = special education status; SS = sums of squares; *Wilks' Λ* = Wilks' Lambda

To examine the nature of the interaction, follow-up independent *t*-tests were conducted with treatment condition as the independent variable and mean scores of the three subtests as the dependent variable for students with and without disabilities separately. Significance of the results was determined by adjusted *p*-values using the Holm-Bonferroni adjustment (Holm, 1979). Adjusted *p*-values of .25 and .50 were used for the first and second comparisons respectively. The independent *t*-tests revealed that mean differences between conditions were not statistically significant for students without disabilities, $t(17) = -0.78$, $p = .45$. A significant mean difference, however, was found between conditions for students with disabilities, $t(25) = 3.25$, $p = .003$. Figure 6 illustrates these results. The interaction plot shows that students without disabilities who received DBI performed slightly lower than control students without disabilities, and students with disabilities who received DBI outperformed control students with disabilities.

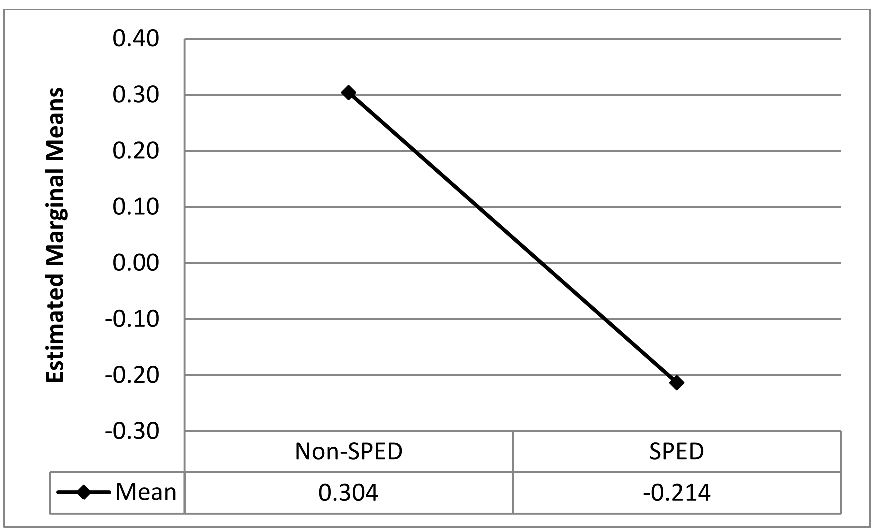

Figure 5. Estimated marginal means of the WJ III by special education status. Non-SPED = students without disabilities; SPED = students with disabilities

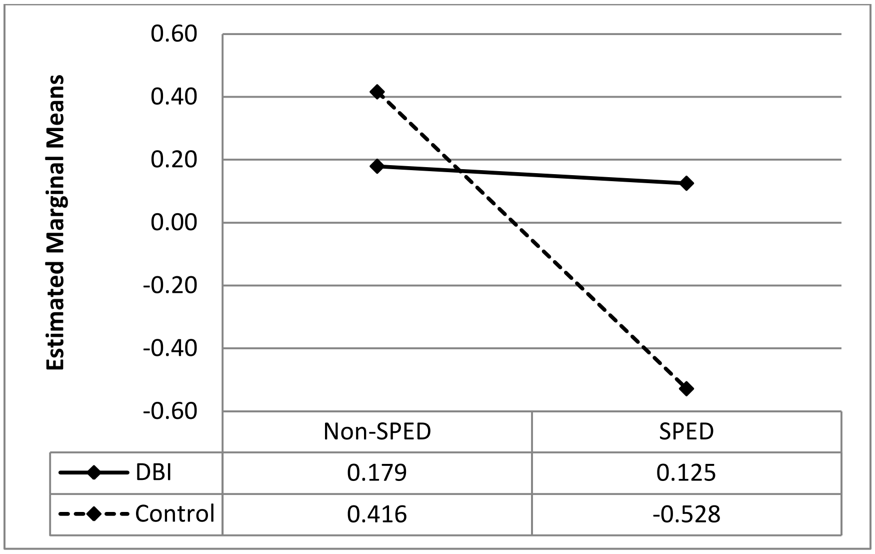

Figure 6. Estimated marginal means of the WJ III by treatment condition and special education status. DBI = data-based instruction; Non-SPED = students without disabilities; SPED = students with disabilities.

Research Question 2

The second research question, "To what extent is DBI feasible to implement with beginning writers?", was addressed by summarizing tutors' responses to the feasibility survey. Tutors rated questions relevant to DBI steps in terms of feasibility, usefulness, and overall satisfaction, and added comments for each rating if needed. They also provided feedback on open-ended questions for each category (see Appendix E for feasibility survey). Results of the tutors' mean ratings for each question under categories of feasibility, usefulness, and overall satisfaction are summarized in Table 12. Tutors' elaborated comments for their ratings and open-ended questions are synthesized below.

Overall Mean Ratings

Overall, tutors provided positive ratings. The average rating was over 3.0 for each category of feasibility, usefulness, and overall satisfaction with a possible range of 1 to 4

(1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree). In general, the mean rating for usefulness was higher (3.4 out of 4) than mean ratings for feasibility and overall satisfaction (3.1 out of 4 for both categories). More specifically, tutors reported relatively low ratings (mean = 2.8 out of 4) on the item, "Generating hypothesis about appropriate method to individualize instruction for the student was feasible" (Step 6), even though they thought it was a useful activity and were satisfied with the procedure (mean = 3.3 for usefulness and 3.0 for overall satisfaction). The tutors thought choosing instructional options from the data-based decision making (DBDM) rubric was feasible and useful (3.2 for feasibility and usefulness) but reported relatively low satisfaction (2.7 for satisfaction) compared to the other steps. The response pattern was similar for "procedures for beginning writing instruction using the CIP" (Step 7). The tutors thought it was feasible and useful (3.2 for feasibility and 3.0 for usefulness) but indicated low ratings for overall satisfaction with the step (2.8 out of 4.0).

Response to the Open-ended Questions

Tutors identified several challenges to implementing DBI. It was challenging for them to make instructional changes for individual students while they worked with a small group of 3 to 4 students. Several tutors commented that students became tired of doing CBM-W twice per week (Step 4) and suggested reducing the frequency of administration and developing additional alternate forms of Picture Word prompts. To make DBI more feasible, tutors wanted more flexibility to change their instruction and more instructional options in the DBDM rubric (Step 6).

Tutors provided positive elaborated comments for the usefulness of DBI. They noted that it was useful to see students' progress and evaluate the effectiveness of their intervention (Step 5), use students' writing samples to identify the writing areas the students needed to improve, design individualized intervention using specific options in the DBDM rubric (Step 6), and document the instructional changes to remember what they tried to change (Step 7). To make DBI more useful, tutors suggested developing additional lesson plans in other writing areas such as sentence- and discourse-level writing.

Tutors provided similar comments on their overall satisfaction with the DBI steps as they did for the feasibility and usefulness of specific aspects of DBI. One tutor liked the opportunity to review students' current performance and discuss instructional decisions as a case example in regular group meetings. Tutors wanted to have more practice time to implement the early writing intervention along with the ongoing DBI process. In addition, they pointed out time-consuming efforts to score and graph CBM-W for individual students.

Table 12

Feasibility Survey Ratings

Questions	*n*	Rating: Strongly Disagree *n* (%)	Disagree *n* (%)	Agree *n* (%)	Strongly Agree *n* (%)	*M* (Range)
Feasibiltiy						
1. Identifying written expression strengths and weaknesses using CBM-W probes and other information was feasible.	6	0 (0)	1 (17)	1 (17)	4 (66)	3.5 (2-4)
2. Generating hypothesis about appropriate method to individualize instruction for the student was feasible.	6	0 (0)	1 (17)	5 (83)	0 (0)	2.8 (2-3)
3. Choosing instructional option from Data-Based Decision Making (DBDM) rubric based on the hypothesis generated was feasible.	6	0 (0)	1 (17)	3 (50)	2 (33)	3.2 (2-4)
4. Creating a Change of Instructional Plan (CIP) for each student or group of students was feasible.	6	0 (0)	1 (17)	4 (66)	1 (17)	3.0 (2-4)
5. Beginning writing instruction using the CIP was feasible.	6	0 (0)	1 (17)	3 (50)	2 (33)	3.2 (2-4)
6. Monitoring progress monitoring twice a week, including scoring and graphing was feasible.	6	0 (0)	1 (17)	2 (33)	3 (50)	3.3 (2-4)
7. Making ongoing changes in instruction based on decision-making rules was feasible.	6	0 (0)	0 (0)	6 (100)	0 (0)	3.0 (3-3)
						3.1 (2-4)
Usefulness						
1. Identifying written expression strengths and weaknesses using CBM-W and other information was a useful activity.	6	0 (0)	1 (17)	1 (17)	4 (66)	3.5 (2-4)
2. Generating hypothesis about appropriate method to individualize instruction for the student was a useful activity.	6	0 (0)	1 (17)	2 (33)	3 (50)	3.3 (2-4)
3. Choosing instructional option from Data-Based Decision Making (DBDM) rubric based on the hypothesis generated was a useful activity.	6	0 (0)	1 (17)	3 (50)	2 (33)	3.2 (2-4)

Questions	*n*	Rating: Strongly Disagree *n* (%)	Disagree *n* (%)	Agree *n* (%)	Strongly Agree *n* (%)	*M* (Range)
Table 10, cont.						
4. Creating a Change of Instructional Plan (CIP) for each student or group of students was a useful activity.	6	0 (0)	0 (0)	3 (50)	3 (50)	3.5 (3-4)
5. Beginning writing instruction using the CIP was a useful activity.	6	0 (0)	1 (17)	4 (66)	1 (17)	3.0 (2-4)
6. Monitoring progress monitoring twice a week, including scoring and graphing was a useful activity.	6	0 (0)	1 (17)	2 (33)	3 (50)	3.3 (2-4)
7. Making ongoing changes in instruction based on decision-making rules was a useful activity.	6	0 (0)	0 (0)	2 (33)	4 (66)	3.7 (3-4)
						3.4 (2-4)
<u>*Overall satisfaction*</u>						
1. Overall, I was satisfied with procedures for identifying written expression strengths and weaknesses using CBM-W and other information.	6	0 (0)	1 (17)	1 (17)	4 (66)	3.5 (2-4)
2. Overall, I was satisfied with procedures for generating hypothesis about appropriate method to individualize instruction for the student.	6	0 (0)	1 (17)	4 (66)	1 (17)	3.0 (2-4)
3. Overall, I was satisfied with procedures for choosing instructional option from Data-Based Decision Making (DBDM) based on the hypothesis generated.	6	0 (0)	2 (33)	4 (66)	0 (0)	2.7 (2-3)
4. Overall, I was satisfied with procedures for creating a Change of Instructional Plan (CIP) for each student or group of students.	6	0 (0)	0 (0)	5 (83)	1 (17)	3.1 (3-4)
5. Overall, I was satisfied with procedures for beginning writing instruction using the CIP.	6	0 (0)	1 (17)	5 (83)	0 (0)	2.8 (2-3)
6. Overall, I was satisfied with procedures for monitoring progress monitoring twice a week, including scoring and graphing.	6	0 (0)	2 (33)	2 (33)	2 (33)	3.0 (2-4)
7. Overall, I was satisfied with procedures for make ongoing changes in instruction based on decision-making rules.	6	0 (0)	0 (0)	4 (66)	2 (33)	3.3 (3-4)
						3.1 (2-4)

CHAPTER V

DISCUSSION

Data-based instruction (DBI) is a systematic process to help teachers individualize instruction for students who need the most intensive interventions. Previous studies have supported (a) the effects of a DBI framework for improving students' academic performance, (b) the effects of research-based intervention in early writing (specifically handwriting and spelling) for improving students' writing performance, and (c) the technical adequacy of CBM in writing (CBM-W) for monitoring progress of beginning writers. No research has been conducted yet to examine the effects of DBI combining these three components to improve outcomes for students in early elementary grades who struggle to learn to write.

The primary purpose of this study was to evaluate the effects of DBI on the early writing performance of children identified as at risk or having disabilities that affect their writing skills depending on students' special education status and type of writing skills. More specifically, DBI in early writing was compared to business as usual writing instruction, and writing performance of students in Grades 1 to 3 was measured by CBM-W and a standardized measure of writing achievement. The feasibility of DBI was examined as a secondary purpose. In this chapter, I discuss the results with respect to the primary and secondary research questions. I end with a discussion of limitations and implications for research and practice.

Effect of DBI on Curriculum-Based Measures of Writing (CBM-W)

For CBM-W Picture-word prompts, a significant main effect of DBI was found between treatment (DBI) and control conditions using four quantitative indices: WW, WSC, CWS, and CIWS. Students who received DBI outperformed those who received business as usual writing instruction, regardless of their special education status. Thus, my hypothesis that students who received early writing intervention along with the DBI process would outperform control students in their writing achievement was met for the writing performance measured by CBM-W Picture Word. The Hedge's *g* effect size value ($g = 0.76$) suggests strong practical significance of DBI. This finding indicates the strong benefits of DBI beyond regular writing instruction for enhancing the early writing performance of students identified as at risk or with disabilities related to writing.

This finding corroborates previous DBI research in reading, mathematics, and spelling (Capizzi & Fuchs, 2005; Fuchs et al., 1984; Fuchs et al., 1989a; 1989b; 1989c; 1989d; Fuchs et al., 1991a; 1991b; Fuchs et al., 1992; Fuchs et al., 1991; Jones & Krouse, 1988; Stecker & Fuchs, 2000; Wesson, 1991), which also showed significant positive effects of DBI for improving students' academic performance. The effects of DBI may be attributed to one or more of the three components of DBI incorporated into this study: a DBI framework, research-based early writing intervention, and technically-sound CBM-W prompts for progress monitoring. In this study, one or more components of the DBI package may have contributed to improved writing outcomes; I elaborate on each of these components below.

First, the DBI framework may have contributed to the improved academic performance for students in this study, for the following reasons. The framework prompted interventionists to evaluate their instructional effectiveness by examining students' academic progress regularly and making instructional decisions based on data-based decision rules—features that are supported by previous research for enhancing students' academic improvement (Fuchs et al, 1989b; Stecker & Fuchs, 2000; Stecker et al., 2005). In addition, DBI helped interventionists individualize intervention based on information from various resources including students' written responses to CBM-W prompts. For example, the choice of instructional options provided in DBDM the rubric helped tutors to come up with instructional modifications. Descriptive information about tutors' instructional adjustments (summarized in Table 7) indicated that tutors did, indeed, make instructional decisions by increasing goals and/or changing instruction for each student using the data-based decision rules. They also used options for instructional changes from the DBDM rubric to modify or change their instruction and document the changes in the Changes in Instructional Plan (CIP). Documenting CIP might have helped tutors build their instructional plans for the modified intervention and keep track the instructional adjustments they tried.

Second, students' improved writing performance might also be explained by the implementation of research-based early writing intervention specifically designed to focus on handwriting and spelling skills. Previous research suggests that explicit handwriting and spelling intervention can improve writing outcome of students in early elementary grades struggling with writing (Berninger et al., 1997; Berninger et al., 1998;

Graham et al., 2002; Graham et al., 2000). In this study, all lesson plans and instructional materials were created by adapting the manual from the Center on Accelerating Student Learning (CASL) handwriting and spelling program developed by Dr. Graham and Dr. Harris (Graham & Harris, 1999), researchers who have devoted much effort to the development of effective intervention for students struggling with writing (e.g., Graham et al., 2002; Graham et al., 2000).

Third, frequent progress monitoring might have contributed to the significant improvements of writing for students who received DBI compared to students in the control condition. Students in the DBI condition were administered CBM-W tasks (either Picture-Word or Word Dictation) for progress monitoring twice per week during the 12 weeks of intervention. Practice effects from the repeated administration of CBM-W may have contributed to the students' improved outcomes. To address the possible practice effects of progress monitoring, students in the control condition were administered CBM-W Picture-Word twice during the study period in addition to the pre-and post-tests, but this might not have been sufficient to control the effects of frequent administration of CBM-W.

No significant main effects of special education status and types of scoring procedures were found on CBM-W across all scoring indices (WW, WSC, CWS, or CIWS). No significant interaction was found among any combinations of the independent variables. According to profile plots, however, a possible three-way interaction appeared between treatment condition and type of scoring procedures by special education status. Different patterns of the effects of DBI were detected depending on different types of scoring procedures. Small negative effects on WW and CWS and moderate positive effects on CWS and CIWS were detected for students who did not receive special education services. High positive effects of DBI were detected across all scoring procedures for students who received special education services.

The possible differential response to DBI based on students' special education status may be related to the nature of the CBM-W scoring procedures. WW represents production of writing regardless of its accuracy and WSC involves spelling accuracy beyond the production of writing. CWS and CIWS take into account accuracy of sequences between words and grammatical features, which are more complex writing skills than WW and WSC. Thus, DBI appeared to have an effect for students without disabilities only when grammar and word usage were taken into account. In other words, students without disabilities may not have needed DBI to improve their production or spelling accuracy, but did appear to need DBI to improve on slightly more complex writing skills. Students with disabilities, however, appeared to need DBI to improve production, accuracy, and more complex writing skills.

The positive findings on slightly more complex writing skills (as measured by CWS and CIWS) for students both with and without disabilities likely relates to the nature of the explicit writing intervention. All writing activities in the lesson plans were scripted with detailed instructional procedures, starting with explicit modeling, guided practice, and independent practice. In addition, for each activity, tutors were expected to provide immediate corrective feedback to students and incorporate instructional information derived from students' CBM-W writing samples into the instruction. Tutors were asked to examine sentences that students generated on CBM-W, identify incorrectly spelled words, and teach those words during the Word Study activity. Tutors also provided corrective feedback on sentence structure and essential components of a complete sentence (e.g., capitalization and punctuation) during sentence- and/or discourse-level writing such as Alphabet Rockets and Writing activities.

Effect of DBI on Woodcock Johnson III Achievement (WJ III) Performance

For the WJ III, a significant main effect of special education status and a significant interaction between treatment condition and special education status, were found on three subtests (Spelling, Writing Fluency, and Writing Samples). There were no statistically different mean differences between conditions for students without disabilities. Students with disabilities who received DBI, however, showed statistically significantly higher performance compared to students with disabilities in the control condition. My hypothesis that providing DBI in early writing would lead to a significant improvement in writing beyond regular writing instruction was partially met for the writing performance measured by the WJ III, but only met for students with disabilities. Students without disabilities might show non-significant mean differences between conditions because the WJ III may not be sensitive to the effects of DBI for those students. In other words, students without disabilities may have improved their writing performance but perhaps not enough to show on the WJ III.

Considering a combination of the three WJ III subtests is categorized as a Broad Written Language cluster, the findings support the benefits of DBI for improving comprehensive, overall writing performance in terms of spelling as well as quantity and quality of writing, for students who receive special education services. This finding is consistent with previous research in early writing intervention, which demonstrated the positive effects of explicit early writing intervention in terms of writing quantity and quality (Berninger et al., 1997; Berninger et al., 1998; Graham et al., 2000; Graham et al., 2002). Students with disabilities might have experienced significant benefits from the early writing intervention compared to those without disabilities because the focus of the intervention was better aligned with their specific writing needs.

Feasibility of DBI

A secondary purpose of this study was to examine the potential feasibility of implementing DBI in schools. The tutors' overall ratings regarding feasibility, usefulness, and their overall satisfaction with DBI were positive. These findings reflect tutors' positive perspectives on DBI and its potential to be implemented by in-service teachers in schools. Higher mean ratings of usefulness compared to ratings of feasibility and overall satisfaction implies the need to improve the feasibility of DBI and support future DBI implementers to increase their satisfaction with delivering DBI.

Results of tutors' ratings on each DBI step revealed that tutors felt they needed more support to implement DBI, especially for steps associated with the data-based decision making process involving (1) generating appropriate hypotheses (Step 6), (2) choosing instructional options (Step 6), and (3) documenting the instructional changes on the change of instructional plan (CIP, Step 7). The ratings on those steps were relatively low compared to ratings on other DBI steps. Below, I discuss the reasons why tutors provided low ratings on these steps and possible ways to meet their needs based on findings from previous research and tutors' comments relevant to the steps.

First, tutors reported that they struggled to generate instructional hypotheses (Step 6) because they had limited information about students' writing performance. In this study, tutors had to generate instructional hypotheses based on students' written responses on CBM-W and observations during their tutoring sessions. They wanted more information about students' writing performance in classrooms and school curriculum to come up with appropriate hypotheses. According to previous research, teachers' use of instructional feedback provided through a synthesized process, called a skills-analysis program, positively influenced students' academic performance (Fuchs et al., 1989a; Fuchs et al., 1990; Stecker & Fuchs, 2000). The nature of skills-analysis feedback -- providing instructionally useful information by synthesizing information from various resources including students' responses to CBM tasks, students' classroom performance in a certain academic area, teachers' judgment, and feasibility to implement the intervention -- might help teachers generate instructional hypotheses and ultimately contribute to improved academic outcomes.

Second, tutors expressed difficulties and felt less satisfaction with choosing instructional options listed in the DBDM rubric (Step 6). Most tutors thought that the DBDM rubric was helpful to determine what they should change based on the instructional options, but that more options would be helpful for their decisions. During the study period, tutors had difficulties finding appropriate instructional options or activities in the DBDM rubric to match their hypotheses. This difficulty is not surprising, considering the heterogeneous nature of students who need the most intensive individualized intervention. More instructional resources could provide useful information for tutors to choose appropriate instructional options or activities. Promising findings of the improved writing performance from this study, however, imply that their hypotheses and subsequent modifications worked well for their students.

Third, tutors revealed less satisfaction with their performance on documenting the instructional changes on the CIP (Step 7). This might be because of the extensive, new professional knowledge and skills they needed to obtain before they started implementing DBI. In previous research, no study has implemented research-based intervention as a standardized protocol by following written scripts; instead, teachers delivered the intervention as they did as usual in schools. In this study, however, tutors had to learn multiple components of DBI including use of progress monitoring tools (administering, scoring, and graphing CBM in writing), implementation of research-based early writing intervention (overall structure of the intervention, specific procedures of each writing activity, and use of instructional materials for each writing activity), and application of the data-based decision making process (applying data-based decision rules, using DBDM rubric, and documenting CIP). Tutors pointed out the need for additional practice time to learn the writing activities and DBI process. Thus, future DBI implementers may require additional extensive training and support, beyond that provided in this study.

Limitations

Several features of the current study limit generalization of the findings. The first limitation relates to delivery of DBI as an instructional package. As mentioned above, in this study, DBI was delivered by incorporating several critical components: using the overall DBI framework, implementing research-based early writing intervention, and frequently monitoring students' progress using CBM-W with adequate technical features. The observed improvement should be interpreted as the effects of DBI containing all components as a package. Thus, it is unclear which specific dimensions of DBI contributed to the enhanced writing performance of students. CBM-W was administered two times for control students so that they would be exposed to the same progress monitoring administered to treatment students. This effort was intended to lessen possible practice effects of the frequency of administrating CBM-W for progress monitoring, but might not be sufficient to rule out its impact on students' writing performance.

The second limitation relates to performance differences of students between the two conditions on dependent variables at pre-test. Student participants were assigned randomly into treatment or control conditions within classrooms. There were no statistically significant mean differences between conditions on dependent variables at pre-test. Students in the treatment condition, however, showed a pattern of higher mean performance levels than those in the control condition on all measures. Due to the nature of applied research in special education, in which student participants have heterogeneous characteristics, it is not surprising to find the skewed mean trend between conditions. In addition, the use of random assignment does not guarantee the equivalence of characteristics of participants (Gersten et al., 2005). Thus, future researchers should consider assigning student participants into conditions randomly after matching them on critical variables including dependent variables and/or other characteristics (Gersten et al., 2005). In this study, in order to ensure the equivalence of pre-treatment performance between conditions, statistical adjustments were applied and standardized residuals were used for main analyses. Thus, it is important to keep in mind that the observed findings were drawn from error variances, left-over variances after removing variances accounted by student performance at pre-test.

The third limitation relates to the small sample size. An original power analysis indicated that a sample size of n = 36 was necessary to indicate adequate power for examining the effects of DBI on students' writing performance. However, the decision was later made (after collecting data) to examine the effects of DBI by special education status and type of writing skills. A post hoc power analysis was conducted for "MANOVA: repeated measures, within-between interaction" with two groups using G*Power 3.1.9.2 version. The power analysis indicated that a sample size of n = 54 was needed to indicate adequate power (1- β error probability = .95) to detect an effect size of d = 0.50 when α rate was set to be .05. Thus, the sample size of n = 46 met the minimum criteria of the original power analysis but not the new power analysis.

The findings for CBM-W -- especially derived from profile plots representing a three-way interaction between treatment condition and types of scoring procedures (WW, WSC, CWS, and CIWS) by special education status -- however, imply the possibility of failure to detect significance due to the small number of students. Even though the three-way interaction was not statistically significant (p = .42), the large effect sizes favoring DBI across types of scoring procedures for students with disabilities suggest its potentially strong practical significance.

Implications for Research

Several research implications can be derived from this study. First, given the limitations above, replication of this research with a larger sample size is warranted. Future researchers should consider using random assignment after matching student participants on critical variables (Gersten et al., 2005) to increase the likelihood of equivalent performance between conditions on dependent variables prior to the intervention. Promising evidence of DBI observed provides additional justification for replicating this study. The large effect sizes on writing performance measured by CBM-W (g = 0.76) serve as evidence of positively strong effects of DBI for students who are struggling with writing. In addition, significant interactions between treatment and special education status favoring students with disabilities imply greater benefits of DBI for students with disabilities than for those without disabilities. Thus, future researchers should consider including a sufficient number of students with disabilities and further examining the effects of DBI by students' special education status.

Second, further research is needed to evaluate the effects of DBI by isolating the critical components of DBI addressed above: use of a DBI framework, implementation of research-based early writing intervention, and frequent measurement of progress monitoring using CBM-W with adequate technical features. Given that DBI was delivered as an instructional package by combining all the components, the findings should be interpreted as the effects of a combination of these dimensions. Thus, it is necessary to examine which dimension(s) are essential for improving students' performance. For example, if researchers wanted to examine the effects of DBI beyond frequent progress monitoring, researchers could compare three conditions: progress monitoring only, progress monitoring within a DBI framework, and a control condition.

Third, further research needs to examine the effects of DBI on qualitative aspects of writing performance. In this study, four scoring procedures (WW, WSC, CWS, and CIWS) were used for the main data analyses. The scores represent quantitative aspects of writing in terms of production and accuracy, but do not represent qualitative aspects of writing. Given that writing quality is a critical aspect of written expression in addition to writing quantity, future researchers should consider using a scoring rubric to rate the quality of students' writing samples. Recently, researchers developed a scoring rubric and examined its technical adequacy (Coker & Ritchey, 2010; Ritchey & Coker, 2013). The researchers found that criterion-related validity ranged from r = .42 to .59 with standardized writing assessments and r = .44 to .50 with teacher ratings (Coker & Ritchey, 2010; Ritchey & Coker, 2013). Thus, future researchers should consider the utility of qualitative writing scores in addition to the four scoring procedures used in this study to examine pre- and post-test performance. Given the lack of evidence in terms of sensitivity to writing growth for quality scoring rubric, more technical adequacy evidence is needed before considering its utility within a DBI framework.

Fourth, with the promising evidence of DBI delivered by trained tutors, future researchers should investigate the effects of DBI in early writing delivered by in-service teachers in schools. Tutors' positive ratings on feasibility, usefulness, and overall satisfaction with DBI imply its potential to be implemented in schools. In order to conduct experimental studies in schools with in-service teachers, researchers should carefully consider feasibility issues arisen from this study because DBI requires a lot of professional human resources including time and efforts for implementing, training, and supporting teachers, which are critical for maximizing the effects of DBI (Stecker et al., 2005). Thus, future researchers should consider ways to improve the feasibility of DBI; for example, by identifying appropriate and feasible formats of expert consultation. The usefulness of consultation was supported by tutors' positive comments, but feasibility of providing ongoing consultation in schools is a questionable issue. Given the nature of school dynamics and diverse school cultures, in-service teachers in different schools might prefer different formats of consultation.

Implications for Practice

This study provides several implications for practice. First, DBI is a useful framework for teaching students who need the most intensive individualized intervention. A series of systematic instructional decision making procedures within DBI might help teachers to design individualized intervention by prompting them to examine progress monitoring data, evaluate the effectiveness of their intervention, generate appropriate instructional hypotheses, and modify or change the current instruction. Given that individualized instruction is critical feature of special education (Fuchs & Fuchs, 1995; Fuchs et al., 2010), DBI may serve an effective framework to teach students who need special education services.

Second, teachers should consider teaching explicit transcription skills for struggling beginning writers to improve their writing skills along with DBI. In this study, students received research-based early writing intervention for at least 30 min, three times per week. The intensive explicit early writing intervention might also contribute to improved students' writing performance. In most studies that showed positive effects of explicit early writing intervention (handwriting and spelling), however, the intervention was delivered for 10 to 15 min, which is a relatively brief period of time, indicating that students could get benefits from a brief, supplementary early writing intervention. In this study, the amount of time per session delivered to students was doubled (30 min) to provide comprehensive writing intervention that comprised of a variety of handwriting and spelling activities for different levels of writing, at letter-, word-, sentence-, and discourse levels, to maximize the effects of the writing intervention, and build in time to administer CBM-W.

Third, teachers might benefit from a collaborative peer group to implement DBI in schools. Providing ongoing consultation has been found to be an important component of DBI to improve students' academic performance (Stecker et al., 2005), and peer collaboration has showed comparable effects to individual follow-up consultation (Wesson et al., 1991). One tutor in this study also commented that the regular small group meeting was helpful to determine instructional decisions and resolve issues while they implemented DBI. Possible barriers to form peer collaboration groups would be difficulties to find peer colleagues who want to implement DBI, who are implementing DBI in the same school buildings, or who have difficulties accessing resources for collaborating with peers outside of the same buildings. Web-based online support or collaboration could be an alternative format to resolve such difficulties (Pierce, 2009).

Conclusions

The purpose of this study was to examine whether Data-Based Instruction (DBI) was differentially effective to improve early writing performance of students identified as at risk or with disabilities that affect their writing skills depending on students' special education status and type of writing skills. Given that this is a first examination of DBI in early writing, the extent to which DBI is feasible to implement was also examined as a secondary purpose. Previous studies have supported the effects of DBI for improving students' performance in core academic areas including reading, mathematics, and spelling. This study contributes to the existing DBI literature by extending research to early writing. First, this study provides preliminary promising evidence of DBI for improving writing performance of students who are identified at risk or as having disabilities. In particular, the effects of DBI appear to be more effective for students receiving special education services, at least with the types of interventions that were included in this study. Second, this study supports the potential of DBI to be implemented in schools based on positive perspectives of tutors on DBI in terms of feasibility, usefulness, and overall satisfaction. Third, this study shows the importance of research-based early writing intervention focusing on handwriting and spelling along with DBI for improving students' writing performance. With the promising positive evidence of DBI, future researchers should replicate and extend this study with a larger number of students identified as at risk or having disabilities.

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Appendix A

Teacher Demographics

Table A1

Teacher Demographics

	Elementary Education Teachers (*n* = 3)		Special Education Teachers (*n* = 4)	
	n	*%*	*n*	*%*
Sex (female)	3	100	4	100
Race				
White	3	100	3	75
African American, Asian, American Indian	0	0	1	25
Age				
20-29	1	33.3	0	0
30-39	2	66.6	2	50
40-49	0	0	1	25
50+	0	0	1	25
Highest Degree				
Bachelor's	0	0	0	0
Master's	1	33.3	1	25
Master's + additional coursework	1	33.3	1	25
Ed.S.	1	33.3	2	50
	M (range)	*SD*	*M* (range)	*SD*
Years in current position	4.33 (4-5)	0.6	8.25 (1-25)	11.2
Years in general education	18.00 (5-25)	11.3	8.67 (3-19)	9.0
Years teaching special ed.	7.83 (0-23)	13.1	16.25 (9-28)	9.1
Hours of PD in writing assessment and/or writing instruction	24.00 (24-24)	0	34.25 (12.5-56)	30.8
Students in class/caseload	25.33 (23-27)	2.1	13.5 (9-21)	5.4

Note. Hours of PD in writing = hours in professional development the teachers have received in the last year in the area of writing assessment and/or instruction.

Appendix B

Administration Directions and a Sample: CBM-W Tasks

Directions for Picture-Word Prompts

Materials Needed:

1. Timer
2. Pencils
3. Directions for administration
4. Teacher copy of the task
5. Picture-word task for students

Directions:

Draw a picture of a dog, write the name of the object underneath, make two lines next to it on the board and write a sentence containing the word on the board.

Provide each student with a pencil and a picture-word prompt packet. Place the worksheet face up on the table/desk in front of each student. Students should leave their pencils on their desks.

Say to the students:

Today we are going to do a few writing activities. If you do not want to do them you don't have to. We will only keep the materials for those students who returned their consent forms.

First, I'm going to ask you to write some sentences. You will write one sentence for each picture in your packet. Keep your pencils down. First, let's name the picture on the board.

This is a dog. (Point to the picture on the board.)
What is this word? "dog." (Make sure all students say the word.)
Let's make a sentence with this word. (Ask one or more students to make a sentence with this word. Write this sentence on the two lines next to the picture on the board. Read this sentence aloud to the whole class.)

You will write one sentence for each picture. (Point to the first item in the sample packet.) ***Start at the top, then go down the page. Try to write a sentence for each picture. When you reach the end of a page, continue on to the next page.*** (Show the students what you mean with the sample copy).

Keep writing until I ask you to stop. When I say "stop," raise your hand with your pencil in it, like this (demonstrate).

Remember to do your best work. If you don't know how to spell a word, just make your best guess. If you make a mistake, just cross it out.

Before we begin, let's read each word. Point to each word as I read it. (Read each word aloud to the students. Make sure they follow along.)

Now, everyone should go back to the first page of your packet. Do you have any questions? Turn the page, pick up your pencils, and point your pencils to the first line. When I say "begin", write one sentence for each picture. Make sure all the students are ready to start and say: ***Please begin writing.*** (Start the timer set for 3 minutes).

Monitor students' participation. If individual students pause for about 10 seconds or say they are done before the three minutes have passed, say to the whole class: ***Keep writing until the timer rings.*** This prompt can be repeated if students should pause again. If students reach the stop page before the end of the 3 minutes, quickly mark the time on the stop page.

When the timer rings after 3 minutes say: ***"Stop. Raise your hand with your pencil in it."*** For the second prompt, say: ***Now, everyone turn to Stop Page 1 and put your pencils down.*** (Demonstrate and check to make sure everyone is on the stop page).
Now, we will write some more sentences.
Again, you will write one sentence for each picture. (Point to an item in the sample packet.) ***Start at the top, then go down the page. Try to write a sentence for each picture. When you reach the end of a page, continue on to the next page.*** (Show the students what you mean with the sample copy).

Keep writing until I ask you to stop. When I say "stop," raise your hand with your pencil in it, like this (demonstrate).

Remember to do your best work. If you don't know how to spell a word, just make your best guess. If you make a mistake, just cross it out.

Before we begin, let's read each word. Point to each word as I read it. (Read each word aloud to the students. Make sure they follow along.)

Now, everyone should turn to the next page and point your pencils to the first line. When I say "begin", write one sentence for each picture. Make sure all the students are ready to start and say: ***Please begin writing.*** (Start the timer set for 3 minutes).

Monitor students' participation. If individual students pause for about 10 seconds or say they are done before the three minutes have passed, say to the whole class: ***Keep writing until the timer rings.*** This prompt can be repeated if students should pause again. If students reach the stop page before the end of the 3 minutes, quickly mark the time on the stop page.

When the timer rings after 3 minutes say: ***"Stop. Raise your hand with your pencil in it."*** For the third prompt, say: ***Now, everyone turn to Stop Page 2 and put your pencils down.*** (Demonstrate and check to make sure everyone is on the stop page).
Now, we will write some more sentences.

Again, you will write one sentence for each picture. (Point to an item in the sample packet.) ***Start at the top, then go down the page. Try to write a sentence for each picture. When you reach the end of a page, continue on to the next page.*** (Show the students what you mean with the sample copy).

Keep writing until I ask you to stop. When I say "stop," raise your hand with your pencil in it, like this (demonstrate).

Remember to do your best work. If you don't know how to spell a word, just make your best guess. If you make a mistake, just cross it out.

Before we begin, let's read each word. Point to each word as I read it. (Read each word aloud to the students. Make sure they follow along.)

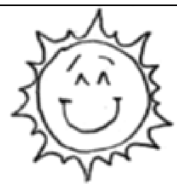
Now, everyone should turn to the next page and point your pencils to the first line. When I say "begin", write one sentence for each picture. Make sure all the students are ready to start and say: ***Please begin writing.*** (Start the timer set for 3 minutes).

Monitor students' participation. If individual students pause for about 10 seconds or say they are done before the three minutes have passed, say to the whole class: ***Keep writing until the timer rings.*** This prompt can be repeated if students should pause again. If students reach the stop page before the end of the 3 minutes, quickly mark the time on the stop page.

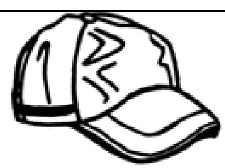
When the timer rings after 3 minutes say: ***"Stop. Raise your hand with your pencil in it."***

A Sample Picture-Word Prompt (Student Copy)

mouse



sun



cap

Directions for Word Dictation Task

Materials Needed: *Stopwatch, teacher copy of word dictation task, directions for administration, student copy of the task, pencil for the student*

Directions:

"Today we are going to do a few writing activities. I would like you to write some words for me. I will read each word two times, and then you will write the word on your paper. It's okay if you don't know how to spell a word. Do your best and then we can move on to the next word. Now we'll try a practice word. Write the word "cat" on your paper. "Cat." *Monitor the student to see that he/she is writing the word on the top line of his/her paper under "example". Don't worry about spelling mistakes. When the student is finished or pauses for more than 5 seconds on the practice word, demonstrate how to write the word on the line.*

"Now, I would like you to write some words. I will say each word two times and you will write it on your paper. When you are finished with one word, move down a line and get ready for the next word. Part way through the activity, I will make a mark on your paper but you just keep working. Do you have any questions? Remember to do your best!" (set timer for 3 minutes) "Here is your first word__" *Start timer after administering the first word. Beginning with the first word, say each word two times, pausing briefly in between. Go on to the next word when the student is finished, or when the student pauses on a word for more than 5 seconds, in which case you would say to the student: "Let's go on to the next word."* Do not *provide any prompts to the student after the initial word reading. You will probably not get through all of the words, but you should set a consistent pace, without rushing the student. Time the student for 3 minutes. At one minute and two minutes, make a slash following the last letter the student wrote on the student copy. When the timer rings, say* **"Stop. Thank you for working so hard. Now we will do another one."**

A Sample Word Dictation Prompt (Student Copy)

WORD DICTATION **A1A2**

Example:

____

Probe A1

1. ____________________	11. ____________________
2. ____________________	12. ____________________
3. ____________________	13. ____________________
4. ____________________	14. ____________________
5. ____________________	15. ____________________
6. ____________________	16. ____________________
7. ____________________	17. ____________________
8. ____________________	18. ____________________
9. ____________________	19. ____________________
10. ____________________	20. ____________________

Sample Word Dictation Prompts (Word List: Form A1 and Form A2)

A1	A2
1. mud	21. bait
2. have	22. mile
3. trip	23. of
4. drove	24. cut
5. trade	25. the
6. grade	26. after
7. spit	27. drag
8. page	28. boil
9. sake	29. gave
10. sport	30. stale
11. print	31. coal
12. log	32. woke
13. ran	33. fan
14. are	34. sniff
15. those	35. drop
16. weed	36. smog
17. joke	37. clasp
18. was	38. slope
19. soil	39. because
20. trend	40. bed

Appendix C

Accuracy of Implementation Rating Scale (AIRS)

Implementer:	Group #:
Date:	Observer/rater:
Start time:	End time:

Part I. Administering the Assessment. Observe the assessment implemented by the implementer, complete the checklist to the extent that the components were administered, and write detailed notes regarding other components observed.

	Yes 1	No 0	N/A	Observation notes:
1. Has materials on hand				
a. Timer				
b. Pencils				
c. Directions for administration				
d. Teacher copy of the task				
e. Picture-word task for students				
2. Following the directions in order				
a. Presents an example of Picture-word prompt on the board				
b. Provides a pencil and a Picture-word prompt packet to each student				
c. Places student copy in front of each student				
d. Demonstrates how students should complete the entire Picture-word task with the sample copy				
e. Reminds students to do their best work				
f. Demonstrates how to deal with spelling difficulties while taking test				
g. Prompts students to continue working until the timer rings				
3. Overall demonstration skills: clearness and responsiveness				
a. Reads directions accurately				
b. Demonstrates by pointing when appropriate				
c. Makes sure students' responses are correct				

4. Timing				
a. Says “Please begin writing”				
b. Starts/stops timer at the correct times				
c. Times students for 3 minutes				
d. Says “Stop. Raise your hand with your pencil in it.”				

Part II. Scoring the Assessment. Check the implementer’s scoring for accuracy.

	Yes 1	No 0	N/A	Observation notes:
Scoring for Correct Word Sequences (CWS)				
a. Sentences are correctly marked by placing vertical lines				
b. Sentences are correctly marked by placing vertical lines				
c. Incorrect words are correctly underlined				
d. Upper carets are used to indicate correct word sequences				
e. Lower carets are used to indicate incorrect word sequences				
f. CWS are counted accurately				

Part III. Documenting Assessment Outcomes. Inspect CBM graphs as well as any other documentation system implemented by the implementer. Complete the checklist and provide a description of other assessment documentation approaches used by the implementer.

	Yes 1	No 0	N/A	Observation notes:
Graph Set-up				
a. Dates are correctly labeled on X-axis				
b. CWS is correctly labeled on Y-axis				
c. Data points are correctly plotted				
d. Absences are indicated				
Goal Line				
a. Long-range goal is correctly calculated				
b. A goal line is drawn from baseline to the long-range goal				

Part IV. Using Assessment Outcomes. Inspect the implementer's documentation of instructional changes in DBI Logs and compare to student graphs

	Yes 1	No 0	N/A	Observation notes:
Use of Decision Rules				
a. A decision was made based on a decision rule				
b. The decision rule was applied at the appropriate time, based on data				
c. An instructional change based on the decision rule is noted				
d. A rationale is provided for the instructional change				

Part V. Implementing Writing Instruction. Observe the instruction implemented by the implementer, complete the checklist to the extent that the components were included, and write detailed notes regarding other components observed.

	Yes 1	No 0	N/A	Observation notes:
Instructional Elements of the WIP				
a. All writing activities are delivered.				
b. The tutor implements the writing intervention using modeling, guided practice, and independent practice.				
c. Students respond to the tutor's instruction and the tutor provide appropriate corrective feedback to the students.				

Appendix D

Writing Intervention Checklists

Name: ______________________ School: _____________________

FIDELITY Check 1 Score: ______# of Yes/18 ______% of Yes
FIDELITY Check 2 Score: ______# of Yes/34 ______% of Yes
FIDELITY Check 3 Score: ______# of Yes/16 ______% of Yes

Intervention Fidelity Checklist 1

Introduction	**Yes**	**No**	**Note**
Introduce activities and rules	1	0	
Set a goal for the day	1	0	
Phonics Warm-up	**Yes**	**No**	**Note**
Show and point to the picture and say, **This picture is a ____. What is this picture?**	1	0	
Turn the card over and point to the word and say, **This word is ____. What word?**	1	0	
Say the location and sound of the target letter.	1	0	
Provide immediate corrective feedback for errors (if needed).	1	0	
Word Building (Lesson 1 and 3)	**Yes**	**No**	**Note**
Place a card containing the rime and say the rime.	1	0	
Model how to make a word by adding a letter at the front of the rime.	1	0	
Have student make as many real word as possible and say the words out loud.	1	0	
Word Building (Lesson 2 and 4)	**Yes**	**No**	**Note**
Place a worksheet containing the rime and say the rime.	1	0	
Tell the student that s/he is going to make word by adding a letter at the front of the rime.	1	0	
Model how to make a word by writing the rime on the line, and then adding the letter(s) to the rime. (If *necessary, illustrate with one or more words.)*	1	0	
Have student make as many real word as possible and say the words out loud.	1	0	
Alphabet Rockets	**Yes**	**No**	**Note**
Read the sentence on the worksheet.	1	0	
Read the sentence together.	1	0	
Have student copy the sentence quickly and correctly for 3-min.	1	0	
Provide corrective feedback on the sentences written (e.g., spacing, capitalization, etc.)	1	0	
Closing	**Yes**	**No**	**Note**
Lesson wrap-up: summarize lessons	1	0	

Intervention Fidelity Checklist 2

Introduction	**Yes**	**No**	**Note**
Introduce activities and rules	1	0	
Set a goal for the day	1	0	
Alphabet Practice (Lesson 1 and 2)	**Yes**	**No**	**Note**
Point and say the letter name on the Alphabet Card. **This letter's name is "". What is the letter's name?**	1	0	
Model how to write each letter on the Alphabet Card by tracing them with index finger while describing the process aloud.	1	0	
Have the student trace each letter on the Alphabet Card.	1	0	
Repeat the process above for the other two letters.	1	0	
Discuss how the target letters are similar and different (using two target letters at each time).	1	0	
Have the student practice on the worksheet while saying the letter aloud:	NA	NA	NA
▪ Student traces each letter with a pencil.	1	0	
▪ Student writes the letter within the lines.	1	0	
▪ Student writes the letter and asks to write from memory.	1	0	
▪ Have student circle the best letter written.	1	0	
Alphabet Practice (Lesson 3 and 4)	**Yes**	**No**	**Note**
Review the letter formation by modeling how to write each letter on the Alphabet Card by tracing them while describing the process aloud.	1	0	
Have student trace each letter on the Alphabet Card.	1	0	
Repeat the process above for the other two letters.	1	0	
Have student practice on the worksheet while saying the letter aloud:	NA	NA	NA
▪ Student traces each letter with a pencil.	1	0	
▪ Student writes the letter 3 times.	1	0	
▪ Student circles the best letter written.	1	0	
Student writes all of the words that contain that letter.	1	0	
Have student circle the best word written.	1	0	

Word Study	**Yes**	**No**	**Note**
Point to the word on the card and say. **This word is ___, what word?**	1	0	
Model the Word Study procedure on the Word Study chart.	1	0	
Demonstrate how to use the strategy using one of student's spelling word.	1	0	
Give each student a pencil and a paper with numbered lines.	1	0	
Have student practice using the strategy with their spelling words. (Help as needed by referring to the Word Study chart).	1	0	
Count correct number of practices and record the score on paper.	1	0	
Writing (Day 1)	**Yes**	**No**	**Note**
Ask students to write a story or a personal narrative. Encourage student to use words that each student has been working on.	1	0	
Read the prompt to the student.	1	0	
Discuss the topic with students and ask to write about it.	1	0	
Tell the student that the teacher cannot help them spell any words.	1	0	
Writing (Day 2)	**Yes**	**No**	**Note**
Have the student read the story to you.	1	0	
Praise at least one or two parts of the paper.	1	0	
Put a star mark next to all correctly spelled words that the student is working on.	1	0	
Help student to correct any misspelled words that the student is working on.	1	0	
Closing	**Yes**	**No**	**Note**
Lesson wrap-up: summarize lessons	1	0	

Intervention Fidelity Checklist 3

Introduction	**Yes**	**No**	**Note**
Introduce activities and rules	1	0	
Set a goal for the day	1	0	
Step1: Teacher Directed Sort [Demonstration]	**Yes**	**No**	**Note**
Place the Master Word Cards next to each other in a row and pronounce the first Master Word.	1	0	
Ask students how the Master Words are alike and different.	1	0	
Tell students you are going to look at some other words that are like these and decide which category they should go under.	1	0	
Show students each word, saying it, and pronouncing it again emphasizing the target feature. Place the word under the appropriate category. Model decision making process.	1	0	
Let students start helping place the cards. Students read the word aloud and then place it in a category, explaining why it goes there.	1	0	
If students make a mistake at the very beginning, correct it immediately.	1	0	
If a word is placed under the ? category for exception words, ask the student why?	1	0	
Model how to check the sort by reading down each column to listen for sound or look for the pattern.	1	0	
Once all words are sorted, help students state a rule for the patterns observed.	1	0	
Step2: Student Word Sort – Resort I	**Yes**	**No**	**Note**
Leave the Master Words in place, shuffle the cards, and ask students to sort the words, placing them in the proper category.	1	0	
Time how long it takes the students to complete this task.	1	0	
Step3: Student Word Sort – Resort II	**Yes**	**No**	**Note**
If enough time is available, tell the students how long it took them to complete the sort, and ask them to do it again, this time beating the previous sorting time.	1	0	
Step4: Student Sort – Additional Words	**Yes**	**No**	**Note**
If time permits, Ask students to sort their own set of words cooperatively or independently under teacher's supervision. During this activity, do not correct your students, but have them name the words in each column to check themselves	1	0	
Closing	**Yes**	**No**	**Note**
Lesson wrap-up: summarize lessons	1	0	

Appendix E

Feasibility Survey

Please complete the following survey regarding the feasibility, usefulness, and your overall satisfaction with your use of DBI for beginning writers as part of this study.

FEASIBILITY	**1**	**2**	**3**	**4**	**Comments**
1. Identifying written expression strengths and weaknesses using CBM-W probes and other information was feasible.	Strongly Disagree	Disagree	Agree	Strongly Agree	
2. Generating hypothesis about appropriate method to individualize instruction for the student was feasible.	Strongly Disagree	Disagree	Agree	Strongly Agree	
3. Choosing instructional option from Data-Based Decision Making (DBDM) rubric based on the hypothesis generated was feasible.	Strongly Disagree	Disagree	Agree	Strongly Agree	
4. Creating a Change of Instructional Plan (CIP) for each student or group of students was feasible.	Strongly Disagree	Disagree	Agree	Strongly Agree	
5. Beginning writing instruction using the CIP was feasible.	Strongly Disagree	Disagree	Agree	Strongly Agree	
6. Monitoring progress monitoring twice a week, including scoring and graphing was feasible.	Strongly Disagree	Disagree	Agree	Strongly Agree	
7. Make ongoing changes in instruction based on decision-making rules was feasible.	Strongly Disagree	Disagree	Agree	Strongly Agree	
8. How could the feasibility of the DBI process be improved for instructional decision making for beginning writers.					

USEFULNESS	1	2	3	4	Comments
9. Identifying written expression strengths and weaknesses using CBM-W and other information was a useful activity.	Strongly Disagree	Disagree	Agree	Strongly Agree	
10. Generating hypothesis about appropriate method to individualize instruction for the student was a useful activity.	Strongly Disagree	Disagree	Agree	Strongly Agree	
11. Choosing instructional option from Data-Based Decision Making (DBDM) rubric based on the hypothesis generated was a useful activity.	Strongly Disagree	Disagree	Agree	Strongly Agree	
12. Creating a Change of Instructional Plan (CIP) for each student or group of students was a useful activity.	Strongly Disagree	Disagree	Agree	Strongly Agree	
13. Beginning writing instruction using the CIP was a useful activity.	Strongly Disagree	Disagree	Agree	Strongly Agree	
14. Monitoring progress monitoring twice a week, including scoring and graphing was a useful activity.	Strongly Disagree	Disagree	Agree	Strongly Agree	
15. Make ongoing changes in instruction based on decision-making rules was a useful activity.	Strongly Disagree	Disagree	Agree	Strongly Agree	
16. How could the DBI process be made more useful for instructional decision making for beginning writers?					

OVERALL SATISFACTION	1	2	3	4	Comments
17. Overall, I was satisfied with procedures for identifying written expression strengths and weaknesses using CBM-W and other information.	Strongly Disagree	Disagree	Agree	Strongly Agree	
18. Overall, I was satisfied with procedures for generating hypothesis about appropriate method to individualize instruction for the student.	Strongly Disagree	Disagree	Agree	Strongly Agree	
19. Overall, I was satisfied with procedures for choosing instructional option from Data-Based Decision Making based on the hypothesis generated.	Strongly Disagree	Disagree	Agree	Strongly Agree	
20. Overall, I was satisfied with procedures for creating a Change of Instructional Plan (CIP) for each student or group of students.	Strongly Disagree	Disagree	Agree	Strongly Agree	
21. Overall, I was satisfied with procedures for beginning writing instruction using the CIP.	Strongly Disagree	Disagree	Agree	Strongly Agree	
22. Overall, I was satisfied with procedures for monitoring progress monitoring twice a week, including scoring and graphing.	Strongly Disagree	Disagree	Agree	Strongly Agree	
23. Overall, I was satisfied with procedures for make ongoing changes in instruction based on decision-making rules.	Strongly Disagree	Disagree	Agree	Strongly Agree	
24. How could the DBI process be improved more satisfaction for instructional decision making for beginning writers?					

Appendix F

Overview of Writing Intervention

The Writing Intervention is divided into 10 units, and each unit has six lessons. The Writing Intervention will be delivered for 30 min. Each lesson in each unit follows the same format and covers different targeted letters/words. During lessons 1 through 5 in each unit, students will do five activities. Lesson 6 is word sort activity.

Description of Activities

	Activity	Description	Materials	Time
Lesson 1 ~ Lesson 5	Phonics Warm-up	This activity is designed to improve students' skills in correctly identifying the letter(s) corresponding to sounds for short vowels, consonants, blends, and digraphs.	Picture Cards	2 min
	Alphabet Practice	This activity is designed to help students correctly and efficiently write the manuscript letters of the alphabet.	Alphabet Cards, pencil, Alphabet practice worksheet	5 min
	Word Building	This activity is designed to practice building words by adding letters to the start of the rime letter. In each unit, two rimes are introduced. Rimes in each unit are paired to illustrate a specific spelling principle.	Rime and onset cards, Letter cards, Stop watch, Pencil	7 min
	Word study	This activity is designed to study a word by saying it, studying its letters, writing it from memory, and checking if it is spelled correctly.	List of words, Word study chart, Paper, Pencil, Study ring, Mastered word rings	7 min
	Alphabet Rockets	This activity is designed to help students correctly and efficiently write the manuscript sentences.	Worksheet, Stop watch	3 min
	Writing	This activity is designed to provide a context in which students can apply the handwriting and spelling skills learned during phonics warm-up, alphabet practice, word building, and word study.	Worksheet, pencil	5min
Lesson 6	Word Sort	Students categorize words by particular features to find generalizations about the spelling of words.	Master word cards, Exception word cards	29min

Lessons of Activities

<table>
<tr><th>Activity</th><th>Lesson 1</th><th>Lesson 2</th><th>Lesson 3</th><th>Lesson 4</th><th>Lesson 5</th><th>Lesson 6</th></tr>
<tr><td>Phonics Warm-up</td><td colspan="5">Across lessons students work with 4 sets of cards. If all pack of cards are mastered, review each pack in order (Sets and packs of cards are in appendix)</td><td rowspan="6">Word Sort</td></tr>
<tr><td>Alphabet Practice</td><td colspan="2">Practice writing 3 target letters</td><td colspan="2">Practice writing words</td><td>Practice writing hinky-pinks</td></tr>
<tr><td>Word Building</td><td>Introduce a rime (e.g., an) and practice building words using cards</td><td>Practice building words using the rime (e.g., an) on worksheets</td><td>Introduce a new rime (e.g., ad) and practice building words using cards</td><td>Practice building words using the rime (e.g., ad) on worksheets</td><td>Review the two rimes</td></tr>
<tr><td>Word study</td><td colspan="5">Students study how to spell words they misspelled in the word spelling test (see appendix). Once a word is mastered, it is removed and a new word is added.</td></tr>
<tr><td>Alphabet Rockets</td><td colspan="5">For each unit, students are asked to write sentence quickly and correctly for 3 min.</td></tr>
<tr><td>Writing</td><td colspan="5">Ask students to write a story or a personal narrative.</td></tr>
</table>

Content for Activities

1. Phonics Warm-up

Set 1: a, e, i, o, u / b, f, r, s, w

Pack A: Initial vowels (a, e, i, o, u) & initial consonants (b, f, r, s, w)	
Apple (short a) Egg (short e) Igloo (short i) Octopus (short o) Umbrella (short u)	Bear (b) Fish (f) Raccoon (r) Seal (s) Wagon (w)
Pack B: Medial vowels (a, e, i, o, u)	
Hat (short a) Bed (short e) Fish (short i) Top (short o) Cup (short u)	Bat (short a) Net (short e) Pin (short i) Lock (short o) Duck (short u)
Pack C: Initial consonants (b, f, r, s, w)	
Bee (b) Fox (f) Ring (r) Saw (s) Watch (w)	Boy (b) Fork (f) Rabbit (r) Socks (s) Web (w)
Pack D: Final consonants (b, f, r, s, w)	
Web (b) Leaf (f) Deer (r) Bus (s) Sub (b)	Bib (b) Spear (r) Tiger (r) Shorts (s) Slipper (r)

Set 2: c, d, g, h, l / m, n, p, t, v

Pack A: Initial consonants (c, d, g, h, l / m, n, p, t, v)	
Cat (c) Dog (d) Goat (g) Horse (h) Lion (l)	Monkey (m) Nest (n) Pig (p) Turtle (t) Valentine (v)
Pack B: Initial consonants (c, d, g, h, l / m, n, p, t, v)	
Cow (c) Desk (d) Girl (g) Hand (h) Lamp (l)	Mouse (m) Nut (n) Pencil (p) Tooth (t) Van (v)
Pack C: Final consonants (m, d, g, l, p, n, t, v)	
Broom (m) Lid (d) Rug (g) Mail (l) Nail (l)	Lamp (p) Sun (n) Cap (p) Boat (t) Cave (v)

Set 3: j, k, qu, y, z / fl, pl, sh, st, th

Pack A: Initial consonants (j, k, qu, y, z) & blends and digraphs (fl, pl, sh, st, th)	
Jeep (j) Key (k) Queen (qu) Yo-Yo (y) Zebra (z)	Flute (fl) Plum (pl) Shark (sh) Star (st) Thumb (th)
Pack B: Initial consonants (j, k, qu, y, z) & blends and digraphs (fl, pl, sh, st, th)	
Jug (j) King (k) Quail (qu) Yarn (y) Zipper (z)	Flower (fl) Plum (pl) Shark (sh) Star (st) Thumb (th)
Pack C: Final consonants (k, x) & blends and digraphs (st, sh)	
Milk (k) Beak (k) Box (x) Fox (x) Desk (k)	Nest (st) Starfish (sh) Brush (sh) Toast (st) Chipmunk (k)

Set 4: br, ch, cl, fr, gr / pr, sk, sn, tr, wh

Pack A: Initial blends and digraphs (br, ch, cl, fr, gr / pr, sk, sn, tr, wh)	
Bread (br) Chair (ch) Clock (cl) Frog (fr) Grape (gr)	Prince (pr) Skunk (sk) Snail (sn) Tree (tr) Wheel (wh)
Pack B: Initial blends and digraphs (br, ch, cl, fr, gr / pr, sk, sn, tr, wh)	
Brick (br) Cheese (ch) Clown (cl) Fruit (fr) Grasshopper (gr)	Princess (pr) Skate (sk) Snake (sn) Train (tr) Whale (wh)
Pack C: Initial blends and digraphs (bl, cr, dr, sp, gl)	
Block (bl) Crab (cr) Dragon (dr) Spider (sp) Glove (gl)	Blanket (bl) Crayon (cr) Drum (dr) Spoon (sp) Glue (gl)

2. Alphabet Practice

- Group 1 (l, i, t) - straight line letters
- Group 2 (o,e,a) - backward curved letters
- Group 3 (n,s,r) - curved letters
- Group 4 (p,h,f) - 2 tall and 1 tailed
- Group 5 (c,d,g) - backward circle
- Group 6 (b,u,m) - curved and 1 tall
- Group 7 (v,w,y) - slant letters
- Group 8 (x,k,z) - slant letters
- Group 9 (j, q) - tailed letters

3. Word building & Word sort

Unit #	**Target sound**	**Target rimes**
Unit 1	short vowel a	an, ad
Unit 2	short vowel (o, e)	ot, en
Unit 3	short vowel (i, u)	it, un
Unit 4	short a – long a	at, ate
Unit 5	short i – long i	in, ine
Unit 6	short o – long o	op, ope
Unit 7	short e – long e	et, eat
Unit 8	long a	ame, ay
Unit 9	"ck" and "k"	ack, ake
Unit 10	double "ll"	all, ill

4. Writing: probes

a. One night I had a strange dream about…
b. It was the last day of school so I decided to…
c. One day, when I got home from school…
d. One day my friend told me the strangest story…
e. I was walking home when I found a $100 bill on the sidewalk and…
f. One morning I found a note under my pillow that said . . .
g. One day I went to school but nobody was there except me, so I…
h. It was a dark and stormy night…
i. I was on my way home from school and…
j. It was the first day of school and…
k. I was watching TV when I heard a knock at the door and…
l. I was talking to my friends when, all of a sudden…
m. One day I woke up and was invisible and…
n. One day I found the most interesting thing and…
o. One summer I went on a trip and…
p. I was walking down the street when I saw...

Appendix G

Writing Instructional Plan (WIP)

Lesson 1

<table>
<tr><td colspan="3">Motivational Plan
During Word Building, Word Study, and Alphabet Rockets activities, the students will receive points when they beat their previous performance or master target words. Points will be also given for appropriate behavior.</td></tr>
<tr><th>Procedures</th><th>Time</th><th>Materials</th></tr>
<tr><td>Objectives and Rules
1. State lesson objectives
Today, we will learn short vowel sound /a/, write the letter a, which makes the sound /a/, and practice spelling words.
2. Introduce rules and point sheet</td><td>30 sec</td><td>Rules, Point sheet</td></tr>
<tr><td>Phonics Warm-up
1. Show and point to the picture and say: This is an apple. What this is?
2. Turn the card over and point to the word. This word is apple. What word?
3. Say the location and sound of the target letter.
○ For first sounds: The first sound in apple is /a/. What sound? What letter makes the /a/ sound?
○ For middle sounds: The middle sound of cat is /a/. What sound? What letter makes the /a/ sound?
○ For last sounds: The last sound of web is /b/. What sound? What letter makes the /b/ sound?
4. Provide immediate corrective feedback for errors:
○ If the student says the incorrect sound: That sound is /a/. Say it with me: /a/. What sound?
Or
○ If the students says the incorrect letter: That letter is “A.” Say it with me: “A.” What letter?</td><td>2 min</td><td>Picture cards</td></tr>
</table>

Alphabet Practice
1. Model how to form each letter on the Alphabet Card by tracing them with your index finger while describing the process aloud. (e.g., l, i, t)
    o Point and say: **This letter's name is "l". Point to the l on the Alphabet Card.**
    What is the letter's name?
    I will show you how to write the letter (Demonstrate while providing guided directions**: Start at the top and pull down until the last line).**
2. Have the student trace each letter on the Alphabet Card.
    I would like you to trace each letter on the Alphabet Card with your finger.
3. Repeat 1 & 2 for the other two letters.
4. Discuss how the target letters are similar and different: (using two target letters at each time)
    How are the letters the same? How are they different?
5. Have the student practice one letter at a time on the practice worksheet:
    o Student traces each letter with a pencil (using the arrowed example letter as a guide), while saying the letter aloud.
        I'm going to have you practice one letter at a time on this worksheet. I would like you to start with the letter [l], trace each letter while you say the letter name out loud.
    o Student writes the letter within the lines, while saying it aloud.
    o Student writes the letter 3 times, while saying it aloud.
        Write [l] three more times on this line while saying it out loud.
    o Student (or teacher) covers the letter on the worksheet, and writes the letter 3 times from memory.
        Now, can you write the letter from your memory?
6. Have student circle the best letter written.
    Can you circle your best [l]?
	5 min	Alphabet cards, pencil, Alphabet practice worksheet

Word Building The student forms words by adding letter(s) to rime. Students work to develop as many real words they can, using letter cards containing a consonant, blend, or digraph. 1. Place a card containing the rime (e.g., -an) on the table and say the rime. **These letters say /an/. What do these letters say? Spell /an/.** (Students say A-N) 2. Model how to make a word by adding a consonant or consonant blend at the front of the rime (e.g., c, d, f, m, r, t, v, cl, pl, sp, th) ○ **We can make real words by adding a letter at the front of these letters.** ○ **(By adding a letter [c]) What word would this be?** ○ **This letter sounds /c/. What sound? These letters sound /an/. What sound?** **Now let's read it together. /c/ /an/ /can/. /can/** **(Show modeling for other words until the student understands)** 3. Have students make as many real words as possible and say the words out loud while the teacher records. ○ **Please show me how to make words by adding a consonant or consonant blend. Say each word out loud as you make them.** After students make a word, ask: **Do you think this is a real word?** ○ *If students make non-real words*: **I know you make a word 'nan'. Think about the 'nan' as a real word.** 4. Once the task is completed, record the amount of times it takes each student to make the words. 5. *If time permits, ask students to do it again and try to beat the time. Continue to repeat this process until the time is up.*	7 min	Stop watch, Rime cards, Letter Cards, pencil

Word Study Administer Word Study Test. Select 5 words to study. Write each word on an index card. **Today, we are going to practice 5 different words. Here is the first word.** 1. Point to the word on the card and say: **This word is ___, what word?** Model the Word Study procedure on the Word Study Chart (Use your fingers to show each step): Using the Word Study Chart and paper with numbered lines, demonstrate how to use the strategy using one of the student's spelling words. **I'm going to teach you how to study your spelling words. You can see this chart to help you remember how to study each word.** **For the first step, I'm going to say the word and study the letters. This word is 'cat'. C.A.T.** **For the second step, I'm going to close my eyes. Say the word and letters. CAT. C.A.T. CAT.** **For the third step, I'm going to say the letters one more time. C.A.T.** **For the fourth step, I'm going to write the word three times. But I'm going to cover up this word so that I can't see it.** **For the fifth step, I'm going to check the word I wrote to make sure it is right.** *1. Say the Word — Study the Letters.* *2. Close Your Eyes — Say the Word and Letters.* *3. Say the Letters Again.* *4. Write the Word Three Times Without Looking.* *5. Check It and Correct It.* 2. Give each student a pencil and a paper with numbered lines. Have the student practice using the strategy with their spelling words. Help as needed by referring to the Word Study Chart. *3.* Count the correct number of practices and record the score on the paper with numbered lines.	7 min	List of words, Word Study Chart, paper, pencil, Study Ring, Mastered Words Ring
Alphabet Rockets Remind students how to write the three letters they learned in Alphabet Practice activity. (e.g., l, i, t) 1. Read the sentence on the worksheet (pointing to each word as you read) and then read the sentence together. 2. Have the student copy the sentence quickly and correctly for 3 minutes. 3. Provide corrective feedback on the sentences written. (e.g., spacing, capitalization, etc.) 4. Count the number of letters copied (after finishing the activity).	3 min	Worksheet, stopwatch

Writing
 	
1. Ask students to write a story or a personal narrative. Encourage the students to use words containing the rimes or other patterns, and word study words that each student has been working on. Read the prompt to the student, discuss the topic with students, and ask to write about it. Tell the student that you cannot help them spell any words.
    ○ **I would like you to write a story. Think about the words we learned and try to write sentences using the words in your story. This story starts... "(Read the story prompt)". (**Ask guiding questions related to the topic of the story.)**I cannot help you spell words. So, if you don't know how to spell the words, make your best guess. When I say begin, start writing. (set the timer) Are you ready? Begin writing.**
2. The student writes for 3 minutes. If the student stops before then, you prompt the student to go on by asking either to say more or add more to a specific part of their response. At the end of 3 minutes, have the student read the story to you.
    ○ **Can you read the story to me?**
3. Praise at least one or two parts of the paper and then put a sticker next to all correctly spelled words that fit the word study rimes, word study words, and word sorting patterns that the student is working on in this and the previous unit.
4. Help the student to correct any misspelled words that fit the word study rimes, word study words, and word sorting patterns.
	5 min	Worksheet

Closing Lesson wrap-up: summarize lessons **e.g., Today, we learned short vowel sound /a/, wrote the letter A, which makes the sound /a/, and practiced spelling words.**	30 sec	
CBM-W administration 1. Administer a CBM-W prompt to students (twice per week) 2. Score and graph following the lesson	3 min	CBM-W probes, Pencils, Timer

Lesson 6

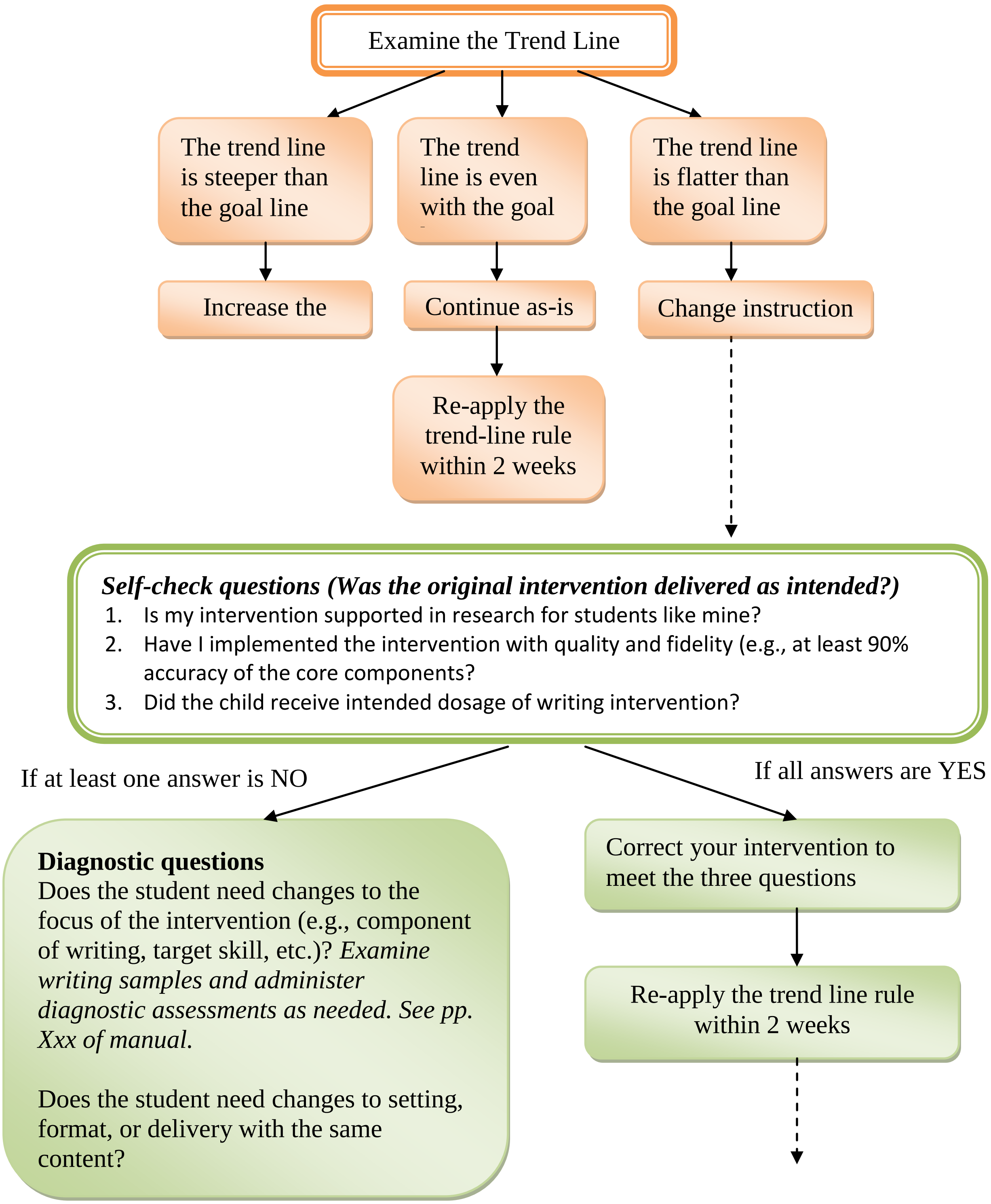
Procedures	Time	Materials
Motivational Plan During Word Sort activity, the students will mark their Point sheet when they beat their previous performance or sort all words correctly. Points will be given for appropriate behavior.		
Objectives and Rules 3. State lesson objectives ○ **Today, we will sort words that have the /a/ and /o/ sounds in the middle.** 4. Introduce rules and point sheet	30 sec	Rules, Point sheet
Word Sorts Step 1: Teacher Directed Sort [DEMONSTRATE] You know that the letter a and o makes different sounds. Today we're going to sort words that have short a and short o in the middle. You'll also find some words that don't follow either pattern. We'll call them our oddballs. 1. Look over words for word sort activity. Be ready to pronounce the words. 2. Place the Master Word Cards (including the "?" card for exception words if included) next to each other in a row (e.g., *man, not*, ?) 3. Pronounce the first Master Word. Say the word again, emphasizing the target feature when saying the word. Repeat this procedure for the other Mater Words. ○ **This word is "man." /m/-/a/-/n/. Mmmmaaaannn.** ○ **This word is "not." /n/-/o/-/t/. Nnnnooottt.** 4. Ask students how the Master Words are alike and different. Direct students' attention to similarities and difference in sounds and letters pertinent to the target features. ○ **Look at the letters in the middle. What are the similarities and differences?** ▪ **"Man" has the short "a" sound, /a/, in the middle. "Not" has the short "o" sound, /o/, in the middle.** ▪ **Both words start and end with a consonant**	29 min	Master Word Cards, Exception Word Cards

5. Tell students you are going to look at some other words that are like these and decide which category they should go under. *If there is ? Master Word (exception word), tell that any word that does not fit under the Master Words will be placed under a special category. (This category is to remind them that there are exceptions to every rule in spelling.)* 6. Show students each word, saying it, and pronouncing it again emphasizing the target feature. Place the word under the appropriate category. Model your decision making process as you do this. ○ **We are going to listen for the middle sounds of these words and decide if they sound like /a/ in *man* or like /o/ in *not*.** ○ **I'll do a few. This word is *can*. /c/-/a/-/n/. Caaan, aaan, aaa. The middle sound of caaan is /a/, so I will put can under man, aaan, aaa. *Can* and *man* both have the /a/ sound in the middle; the /a/ sound is made by the letter a.** 7. After modeling two or three words and once you think students have got the basic idea, let students start helping you place the cards. Continue to hold the cards up one at a time. Students can take turns turning over a word in the stack. Students should read the word aloud and then place it in a category, explaining why it goes there. 8. If students make a mistake at the very beginning, correct it immediately; for example: "***Stop"* would go under "*not*." Its middle sound is /o/.** Then model how to segment the phonemes to isolate the medial vowel: /s/ -/t/-/o/-/p/. 9. If a word is placed under the ? category for exception words, ask the student why? [SORT and CHECK] 10. Model how to check the sort by reading down each column to listen for sound or look for the pattern. ○ **You can check to see if you put words in the right list by reading all the words in each list. Listen to hear if they each have the same middle sound.** [REFLECT] 11. Once all words are sorted, help students state a rule for the patterns observed. ○ **What do you notice about the words in each column? How are the sounds in these words alike? What kind of pattern do you notice?** Avoid telling rules but help student shape their ideas into generalization statements. ○ **e.g., All of these words have the letter "a" in the middle that makes the '/a/' sound. When you hear a short /a/ (or /o/) sound, you spell it with just the letter "a" (or "o"/)."**		

○ **More complicated generalization: When you hear a short /a/ (or /o/) sound in a single syllable word, use just a letter “a” (or “o”) between the consonants** 12. With the generalization now stated that they may be able to apply it to the decoding of unfamiliar words. Step 2: Student Word Sort – Resort I 1. Leave the Master Words in place, shuffle the cards, and ask students to sort the words, placing them in the proper category. 2. Time how long it takes the students to complete this task. Step 3: Student Word Sort – Resort II 1. If enough time is available, tell the students how long it took them to complete the sort, and ask them to do it again, this time beating the previous sorting time. Be sure cards are shuffled and time how long it takes to do the sort. Step 4: Student Sort – Additional Words If time permits, Ask students to sort their own set of words cooperatively or independently under your supervision. During this activity, do not correct your students, but have them name the words in each column to check themselves. (Tutor should be ready to provide corrective feedback if needed (or encourage students to help each other.) ○ **Why did you put this here?** ○ **I see one word in this column that doesn’t fit.**		
Closing Lesson wrap-up: summarize lessons e.g., **Today, we sorted words that have the /a/ and /o/ sounds in the middle.**	30 sec	

Appendix H

Data-Based Decision-Making (DBDM) Rubric



Directions for Choosing Instructional Changes

1. *First, consider trying Changes to Setting and Format, and then trying Changes to Delivery.*
2. *Ask the following questions and choose* **ONE** *option to change your intervention. If you are not sure which question fits your student best, start at the far left column of Changes to Setting and Format or Changes to Delivery, and move from left to right.*

Changes to Setting and Format			Changes to Delivery		
Does student need more time in instruction?	Does student have problem with attention or motivation?	Does student need more individualized interaction?	Does student need more opportunities?	Does student need more explicit instruction?	Does student need more systematic instruction?
↓	↓	↓	↓	↓	↓
Repeat the same lesson Increase the length of activity (min)	Check out with the student and figure out causes for less attention or motivation Shorten the segment of activity – Break Do preference assessment Provide incentives for using the skill Teach the skill in the context of using the skill Provide choices of activities	Spend more one-on-one time during small group intervention Spend more one-on-one time during outside small group intervention Add peer-mediated component to existing activities	Offer individual practice opportunities to the student Use frequent student response to monitor student understanding Provide feedback that relates to student goals and completion of tasks	State purpose and learning goal of lesson Provide models with clear explanations Provide guided practice opportunities Use pictures, manipulative, or "think-aloud" Repeat the directions Provide immediate feedback	Break down tasks into smaller steps Break down instruction into simpler segments Use step-by-step strategies Provide temporary support that can be reduced over time

3. *Implement your change, continue monitoring progress, and repeat the entire decision-making process to evaluate the effects of your instruction.*

Appendix I

Changes in Instructional Plan (CIP)

1. Briefly describe basic nature of current writing program (e.g., target letters/words, attention or motivation, etc.)

• Phonics Warm-up:	• Word Study:
• Alphabet Practice:	• Alphabet Rockets:
• Word Building:	• Word Sorts:

2. If you make instructional decision, what decision would you make? Check one box and briefly describe why you made the decision (e.g., CBM graph, teacher judgment).

	Increase the goal	Rationale:
	Continue as-is	
	Change instruction	

If you choose "change instruction", please see the "Directions for choosing instructional changes" in DBDM rubric and answer questions below.

3. Which instructional option would you choose for the student? Check ONLY one box and briefly describe what data support this decision (e.g., CBM graph, teacher judgment, diagnostic assessments).

Changes to Content		Rationale:
	Sounds in handwriting and spelling instruction	
	Letters in handwriting and spelling instruction	
	Words in handwriting and spelling instruction	
Changes to Setting and Format		
	Does student need more time in instruction?	
	Does student have problem with attention or motivation?	
	Does student need more individualized interaction?	
Changes to delivery		
	Does student need more opportunities?	
	Does student need more explicit instruction?	
	Does student need more systematic instruction?	

4. Briefly describe your instructional change planned. How will you implement your instructional change?

Appendix J

Classroom Observation Sheet

Teacher Name:
School:
Date/Time:
Observer Initial:

Transcription:

- H- Handwriting
- KW - Keyboarding, word processor operation
- S - Spelling
- PC - Punctuation/capitalization
- V - Vocabulary

Text generation/Self-regulation strategies:

- GS - Grammar or sentence formation
- PW - Prewriting
- R - Revising
- E - Editing
- C-N, C-I: Collaborative writing for narrative or informative
- I-N, I-I: Independent writing for narrative or informative

Time (start , end)	Name of activity	Description/ Notes	Dimensions					
			Grouping	**Management of instruction**	**Writing focus**	**Teacher instructional mode**	**Nature of student activity**	**Length of text written**
			Whole class Large group Small group* (L, M, H) Pair Individual	Teacher-managed Child-managed Technology-managed	Transcription (T) ** H KW S PC V TG/SR ** GS PW R E C-N C-I I-N I-I Assessment Text Features Sharing writing by students Sharing writing by teacher	Checking/managing work Conferencing/coaching/scaffolding Discussion Other Presentation Q&A Teacher modeling	Correct/copied written response Drawing Manipulate Open written response Oral response Other Writing about text	Individual letters Individual words Sentence Connected text Marking response Writing numbers

*Level of writing by students in small groups: low, medium, or high. Ask the teacher how small groups were formed to know more about the level of writing.
**Codes for T and TG/SR are above.

Appendix K

Intervention Planning Materials

Intervention Planning Sheet

Week/Day	Days/dates	Notes
Week 1	**2/17-2/21**	
Session 1		
Session 2		
Session 3		
Week 2	**2/24-2/28**	
Session 4		
Session 5		
Session 6		
Week 3	**3/3-3/7**	
Session 7		
Session 8		
Session 9		
Week 4	**3/10-3/14**	
Session 10		
Session 11		
Session 12		
Week 5	**3/17-3/21**	**FIDELITY OBSERVATION**
Session 13		
Session 14		
Session 15		
Week 6	**3/24-3/28**	
Session 16		
Session 17		
Session 18		

Week/Day	Days/dates	Notes
Week 7	**4/7-4/11**	
Session 19		
Session 20		
Session 21		
Week 8	**4/14-4/18**	
Session 22		
Session 23		
Session 24		
Week 9	**4/21-4/25**	
Session 25		
Session 26		
Session 27		
Week 10	**4/28-5/2**	**FIDELITY OBSERVATION**
Session 28		
Session 29		
Session 30		
Week 11	**5/5-5/9**	
Session 31		
Session 32		
Session 33		
Week 12	**5/12-5/16**	
Session 34		
Session 35		
Session 36		

Intervention Log

Tutor first name, last initial:

Day 1	**Student name**	**Attendance**	**CBM-W**	**Start time**	**End time**
Date:			Y / N		
			Administrating		
			Scoring		
			Graphing		
Additional notes:					

Day 2	**Student name**	**Attendance**	**CBM-W**	**Start time**	**End time**
Date:			Y / N		
			Administrating		
			Scoring		
			Graphing		
Additional notes:					

Day 3	**Student name**	**Attendance**	**CBM-W**	**Start time**	**End time**
Date:			Y / N		
			Administrating		
			Scoring		
			Graphing		
Additional notes:					

Day 4	**Student name**	**Attendance**	**CBM-W**	**Start time**	**End time**
Date:			Y / N		
			Administrating		
			Scoring		
			Graphing		
Additional notes:					

Progress Track Log

	Activities	Unit	Lesson	Notes
Day 1 Date:	Phonics Warm-up			
	Alphabet Practice			
	Word Building			
	Word Study			
	Alphabet Rockets			
	Writing			
	Word sort			
Day 2 Date:	Phonics Warm-up			
	Alphabet Practice			
	Word Building			
	Word Study			
	Alphabet Rockets			
	Writing			
	Word sort			
Day 3 Date:	Phonics Warm-up			
	Alphabet Practice			
	Word Building			
	Word Study			
	Alphabet Rockets			
	Writing			
	Word sort			

Appendix L

DBI Progress Monitoring Meeting Note-Taking

Meeting Attendees	
Intervention Provider	
Note-Taker	

1. Summarize Implementation Plan
Student:
Summary of implementation: Group size: Setting:
2. Review Progress Monitoring Data and Additional Data
Review of progress monitoring data: Is the student making adequate progress toward his/her goal(s)? • Are the 4 most recent progress monitoring data points above or below the goal line? • Is the student's trend line flatter or steeper than the goals line? • Other information?
Visible trend in student data: ☐ Very low scores ☐ Highly variable scores ☐ Goal line steeper than trend line ☐ Trend line steeper than goal line ☐ Flat trend line ☐ Flattened scores after teaching change ☐ Increasing scores after teaching change
Description of intervention implementation: Describe any factors that have impacted the implementation of the plan (e.g., scheduling, attendance, resources, behavior, etc.)?

3. Group Questioning: Is the Plan Working?

Summary of questions and responses: (review about the previous changes)

4. Problem-Solve, Prioritize, and Plan

Problem-solve:

Based on the student data, is change to the student's intervention program needed? If so, what type?

- **Changes to Setting and Format**
- **Changes to Delivery**
- **Changes to Content**
- **Other changes**

Plan:

Which changes would you choose and how to apply the changes to writing activities?

Appendix M

Preliminary Analyses: Tables and Figures

Table M1

A Comparison between Students Missing Data Included and Excluded: CBM-W Picture Word Prompts

	Students missing posttest were included			Students missing posttest were excluded		
	df	*F*	*p*	*df*	*F*	*p*
Treatment	1, 44	2.567	0.116	1, 42	2.855	0.099
SPED	1, 44	1.815	0.185	1, 42	1.254	0.269
Scoring Type	3, 42	68.494	<.001*	3, 40	71.024	<.001*
Treatment * SPED	1, 44	0.963	0.332	1, 42	1.314	0.258
Treatment * Scoring Type	3, 42	1.065	0.374	3, 40	1.482	0.234
SPED * Scoring Type	3, 42	0.553	0.649	3, 40	0.866	0.467
Treatment * SPED * Scoring Type	3, 42	1.517	0.224	3, 40	1.428	0.249

Note. MANOVA = repeated measures multivariate analyses of variance; CBM-W = curriculum-based measures in writing; SPED = special education status.
*p < .05. **p < . 001.

Table M2

A Comparison between Students Missing Data Included and Excluded: The WJ III

	Students missing posttest were included			Students missing posttest were excluded		
	df	*F*	*p*	*df*	*F*	*p*
Treatment	1, 44	1.854	0.180	1, 42	2.170	0.148
SPED	1, 44	6.933	0.012*	1, 42	5.203	0.028*
Subtest Type	2, 43	52.078	<.001**	2, 41	50.337	<.001**
Treatment * SPED	1, 44	3.503	0.068	1, 42	4.893	0.032*
Treatment * Subtest Type	2, 43	1.140	0.329	2, 41	1.101	0.342
SPED * Subtest Type	2, 43	3.229	0.049	2, 41	2.343	0.109
Treatment * SPED * Subtest Type	2, 43	2.123	0.132	2, 41	2.859	0.069

Note. MANOVA = repeated measures multivariate analyses of variance; WJ III = Woodcock Johnson III Achievement of Test; SPED = special education status.
* p < .50. **p < . 001.

Table M3

Results of Shapiro-Wilk Test on CBM-W Scores

	DBI			Control		
	Statistics	*n*	*p*	Statistics	*n*	*p*
WW	0.964	22	.566	0.989	24	.992
WSC	0.945	22	.248	0.961	24	.465
CWS	0.940	22	.195	0.940	24	.161
CIWS	0.953	22	.361	0.971	24	.699

Note. CBM-W = curriculum-based measures in writing; DBI = data-based instruction; WW = words written; WSC = words spelled correctly; CWS = correct words sequences; CIWS = correct minus incorrect words sequences.

Table M4

Correlation Coefficients among CBM-W Scores by Type of Scoring Procedures

	WW	WSC	CWS	CIWS
WW		0.951*	0.869*	0.599*
WSC			0.897*	0.656*
CWS				0.894*
CIWS				

Note. CBM-W = curriculum-based measures in writing; WW = words written; WSC = words spelled correctly; CWS = correct words sequences; CIWS = correct minus incorrect words sequences.
*$p < .05$.

Table M5

Results of Shapiro-Wilk Test on the WJ III Scores

	DBI			Control		
	Statistics	*n*	*p*	Statistics	*n*	*p*
Spelling	.959	22	.474	.894	24	.016*
Writing Fluency	.919	22	.073	.683	24	<.001***
Writing Samples	.925	22	.097	.943	24	.192

Note. WJ III = Woodcock Johnson III Achievement of Test; DBI = data-based instruction.
* $p < .50$. ***$p < .001$.

Table M6

A Comparison between Included and Excluded Outliers: The WJ III

	Included outliers			Excluded outliers		
	df	*F*	*p*	*df*	*F*	*p*
Treatment	1, 42	1.422	0.240	1, 36	0.540	0.467
SPED	1, 42	8.162	0.007*	1, 36	6.140	0.018*
Subtest Type	2, 41	0.018	0.982	2, 35	0.284	0.754
Treatment * SPED	1, 42	6.613	0.015*	1, 36	5.412	0.026*
Treatment * Subtest Type	2, 41	2.696	0.079	2, 35	0.658	0.524
SPED * Subtest Type	2, 41	0.179	0.837	2, 35	0.330	0.721
Treatment * SPED * Subtest Type	2, 41	2.106	0.135	2, 35	2.776	0.076

Note. MANOVA = repeated measures multivariate analyses of variance; WJ III = Woodcock Johnson III Achievement of Test; SPED = special education status
*$p < .50$.

Table M7

A Comparison between Included and Excluded Outliers for the Interaction between Treatment Condition and Special Education Status: The WJ III

	Included outliers			Excluded outliers		
	df	*t*	*p*	*df*	*t*	*p*
Students with disabilities	25	3.25	.003**	22	3.01	<.001
Students without disabilities	17	-0.78	0.45	14	0.08	0.94

**$p < .01$.

Table M8

Correlation Coefficients among the WJ III Subtest Scores

	Spelling	Writing Fluency	Writing Samples
Spelling		.001	.295*
Writing Fluency			.290
Writing Samples			

Note. WJ III = Woodcock Johnson III Achievement of Test.
*$p < .50$.

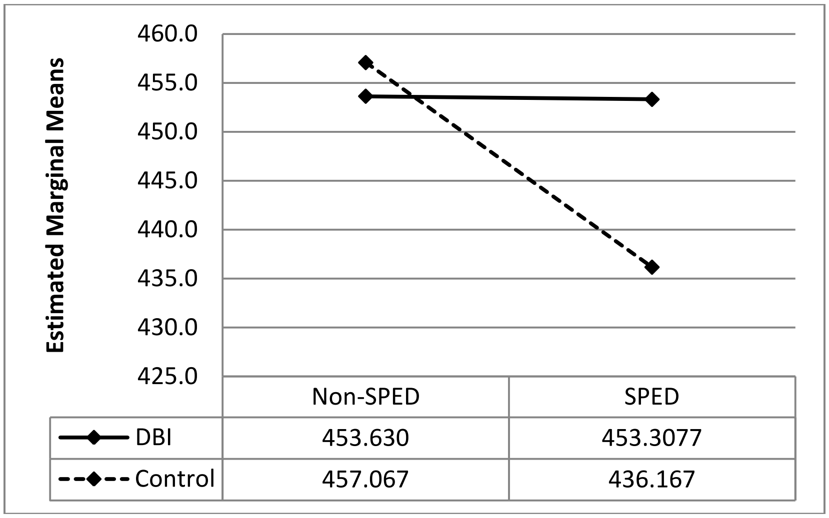


Figure M1. Estimated marginal means of WJ III by treatment condition and special education status: Pre-test. DBI = data-based instruction; Non-SPED = students without disabilities; SPED = students with disabilities.

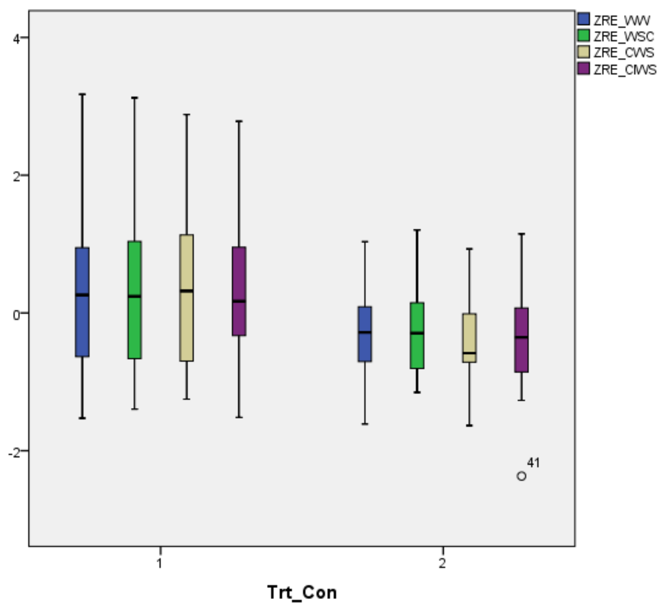


Figure M2. Box plots by types of scoring of CBM-W across conditions. All scores were based on standardized residuals. ZRE_WW = words written; ZRE_WSC = words spelled correctly; ZRE_ CWS = correct words sequences; ZRE_CIWS = correct minus incorrect words sequences; 1 = treatment condition; 2 = control condition.

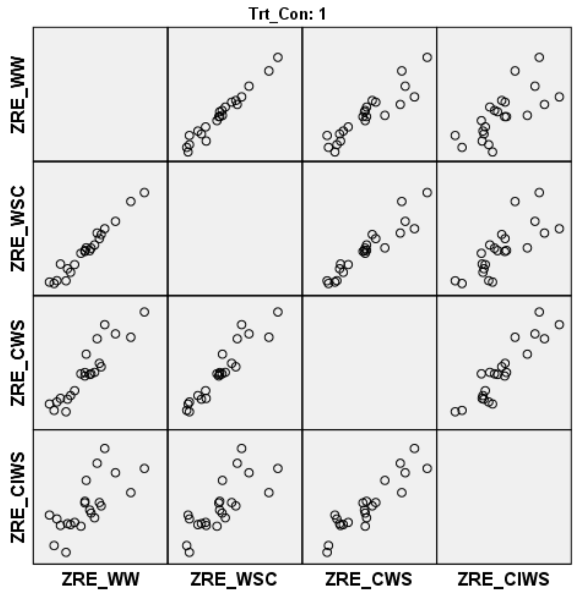


Figure M3. Correlations among CBM-W scores by type of scoring procedures (DBI condition). All scores were based on standardized residuals. ZRE_WW = words written; ZRE_WSC = words spelled correctly; ZRE_ CWS = correct words sequences; CIWS = correct minus incorrect words sequences; 1 = treatment condition.

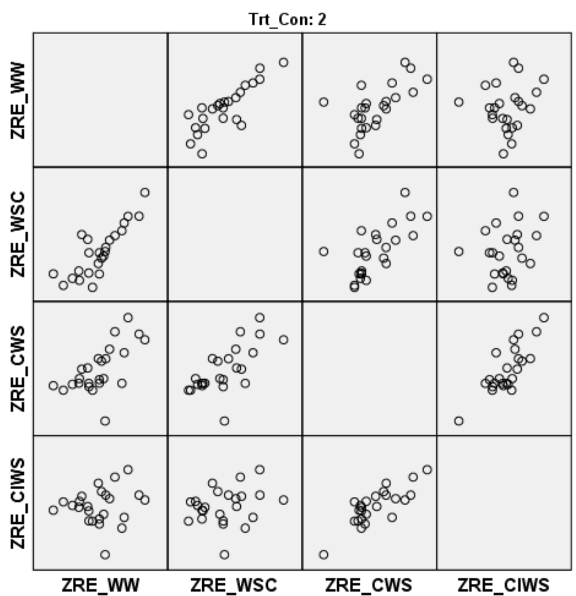


Figure M4. Correlations among CBM-W scores by type of scoring procedures (Control condition). All scores were based on standardized residuals. ZRE_WW = words written; ZRE_WSC = words spelled correctly; ZRE_ CWS = correct words sequences; ZRE_CIWS = correct minus incorrect words sequences; 2 = control condition.

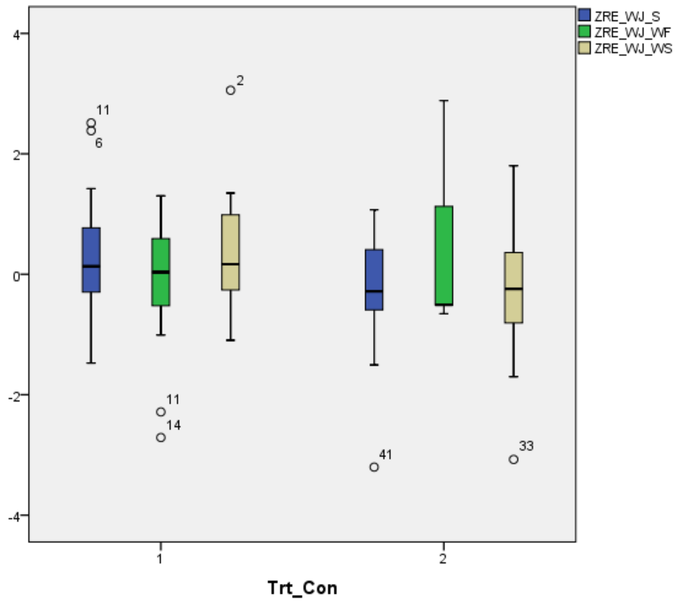


Figure M5. Box plots by the WJ III subtests across conditions. All scores were based on standardized residuals. ZRE_WJ_S = spelling; ZRE_WJ_WF = writing fluency; ZRE_WJ_WS = writing samples; 1 = treatment condition; 2 = control condition.

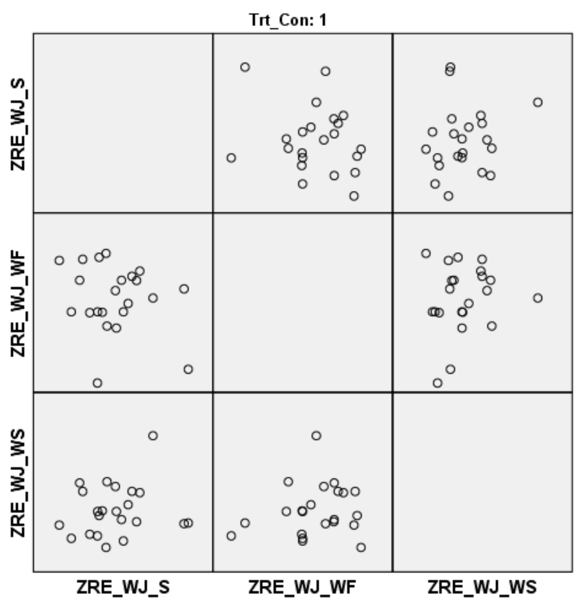


Figure M6. Correlations among the WJ III subtest scores (DBI condition). All scores were based on standardized residuals. ZRE_WJ_S = spelling; ZRE_WJ_WF = writing fluency; ZRE_WJ_WS = writing samples; 1 = treatment condition.

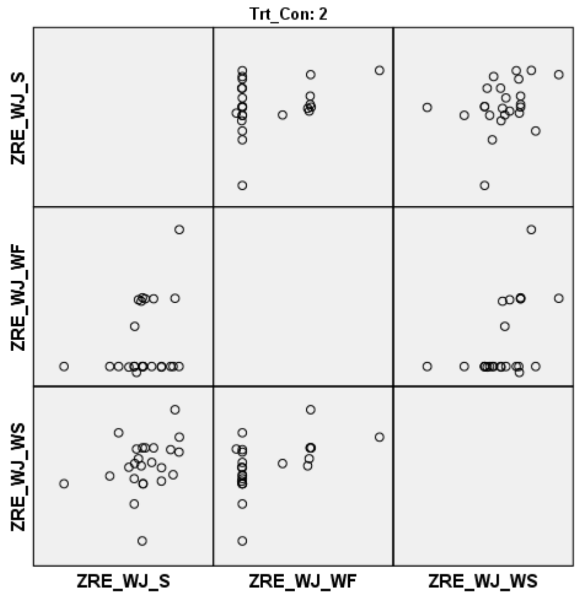


Figure M7. Correlations among the WJ III subtest scores (Control condition). All scores were based on standardized residuals. ZRE_WJ_S = spelling; ZRE_WJ_WF = writing fluency; ZRE_WJ_WS = writing samples; 2 = control condition.