Exploring the Relation Between Teacher Factors and Student Growth in Early Writing

A Thesis

SUBMITTED TO THE FACULTY OF THE UNIVERSITY OF MINNESOTA

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF ARTS

Dr. Kristen McMaster

February 2019

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Acknowledgements

First, I would like to thank my advisor, Dr. Kristen McMaster. Your guidance and mentorship have been beyond what I expected. You have taught me a great deal and I truly appreciate you and all that you have done for me. I would like to further thank Dr. McMaster, along with Dr. Erica Lembke and the members of the DBI-TLC lab, for both collecting and allowing me to use the data that I analyzed for this thesis.

Second, I would like to thank the National Center for Leadership in Intensive Intervention for providing me with funding and opportunities during my graduate career.

Throughout my educational and professional career, I have had the great fortune of being taught and encouraged by many wonderful teachers. In particular, I want to thank the special education department at the University of Wisconsin Eau Claire for providing me with a strong foundation for my career as a special education teacher. Further, I want to thank the many colleagues and students I have had over my years as a special educator. You continue to inspire me to work to make the world better by improving the academic outcomes for students with learning disabilities.

Most importantly, I want to thank my family: my dad, John Cook; my mom, Bobbi Cook, the original special educator in our family; my brothers, Clint and Cole Cook; my sister-in-law, Anna Cook; and a special thank you to my wonderfully supportive husband, Jace Bresina. You all encourage me to strive to be the best me I can be and to put my best effort into everything that I do. You motivate me to live my dreams and I want you to know that all that I am is because of your love and support.

Finally, I want to thank God for my life, abilities, and talents.

To my wonderful family.

Abstract

Data from a small randomized control trial of teachers' use of Data-Based Instruction (DBI) for early writing were analyzed to determine the influence of teacher knowledge, skills, and treatment fidelity on student growth. Participants included 11 elementary grade teachers who delivered intensive intervention in early writing and their students ($n = 31$), all identified as either at-risk for or with disabilities that affect their writing. Teachers received professional development accompanied by ongoing coaching to support the implementation of DBI for improving their students' early writing skills. Results from a multiple regression analysis suggest that teacher knowledge and skills in DBI was strongly related to student growth in early writing. Implications for instructional coaching and improving student writing growth are discussed. Findings also informed improvements to a fidelity measure with the intention to capture more precisely teachers' fidelity of intensive intervention.

Key words: intensive intervention, coaching, early writing, data-based instruction

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Exploring the Relation Between Teacher Factors and Student Growth in Early Writing

Learning to write is an important academic skill necessary for student success in both school and life. Currently, many students with learning disabilities struggle to develop their writing skills. According to the most recent national report on student writing, 60% of eighth-grade students with learning disabilities performed below a basic level in writing (National Center for Education Statistics, 2012). For many of these students, the general education curriculum is unsuccessful at producing sufficient growth in writing. Thus, they will require more intensive instruction for their writing skills to develop sufficiently (D. Fuchs, Fuchs, & Stecker, 2010; Zumeta, 2015).

Data-Based Instruction

A growing body of research supports the use of Data-Based Instruction, also termed Data-Based Individualization (DBI; National Center on Intensive Intervention, 2013; also see Deno & Mirkin, 1977), to intensify and individualize instruction for students with intensive needs (e.g., Coyne et al., 2013; Deno & Mirkin, 1977; McMaster et al., 2018) leading to improved student outcomes (Jung, McMaster, Kunkel, Shin, & Stecker, 2018; Stecker, Fuchs, & Fuchs, 2005), including improvements in early writing (Jung, McMaster, & DelMas, 2017). DBI is a framework that can be used by teachers to take a scientific approach to modifying instruction effectively and efficiently based on individual student need through the use of data. While there is variation in the literature regarding the specific steps of the DBI process, generally, DBI consists of the following core components: (a) determine a student's present level of academic and functional performance, (b) set a long-term performance goal, (c) select and implement a research-based instructional platform and frequently monitor progress, (d) apply decision rules to

determine when instructional modifications are needed based on the data, (e) use data to create hypotheses regarding the student's needs and make instructional changes accordingly, (f) monitor student progress in response to the instructional changes, (g) repeat this process until the long-term goal is reached (Jung et al., 2018).

To monitor student progress and response to instruction for decision-making in a DBI framework, research supports the use of Curriculum-Based Measurement (CBM; Deno, 1985). CBM marries measurement and instruction by providing teachers with a way to frequently and repeatedly measure student performance in a specific domain (e.g., writing) in a quick and easy-to-understand manner that has been shown to produce reliable and valid estimates of student growth (Deno, 1985). Researchers have demonstrated that teachers' use of CBM data to inform their instruction can increase teacher effectiveness and student achievement (L. S. Fuchs, Deno, & Mirkin, 1984; Jung et al., 2018; Stecker et al., 2005). Specific to writing, multiple CBM-Writing tasks are empirically supported for progress monitoring. Specific to monitoring early writing growth, CBM-Writing word dictation, picture-word, and story prompts have empirical evidence supporting their use (for a review of these tasks and others, see McMaster, Ritchey, & Lembke, 2011). These CBM-Writing tasks are used to measure word-, sentence-, and passage-level writing, respectively.

Teacher Knowledge and Skills

Persistent low achievement of students at-risk for or identified with disabilities suggests that schools struggle to provide sufficiently intensive instruction for these students to prosper (McInerney, Zumeta, Gandhi, & Gersten, 2014; Zumeta, 2015). The degree to which teachers are currently individualizing and intensifying instruction to

meet the needs of struggling learners likely varies greatly. Furthermore, the extent to which this individualization and intensification is successful appears to be influenced by both teachers' knowledge of how to effectively and systematically intensify instruction for the individual learner and teachers' literacy content knowledge (e.g., Cunningham, Perry, Stanovich, & Stanovich, 2004; Spear-Swerling & Zibulsky, 2014).

Cutler and Graham (2008) conducted a national survey of elementary teachers' writing knowledge and instructional practices. When asked how adequate teachers felt their pre-service education was in equipping them with the necessary skills and knowledge to effectively deliver writing instruction, a minority described their pre-service education to be above adequate with about one quarter of the teachers surveyed finding their pre-service education to be greatly lacking (i.e., rated as poor) while just under half found their pre-service education to be simply adequate. These findings align with the conclusions from the National Commission on Writing (2003), which describes the neglect of writing in today's classroom instruction and claims that many teachers are insufficiently equipped to teach writing.

In another study where teachers were given free-rein to design a two-hour language arts instructional block however they wished, Spear-Swerling and Zibulsky (2014) found that teacher knowledge in literacy instruction positively predicted whether the teachers chose to include research-based instructional features (e.g., vocabulary, writing assessment, basic writing skills) into their lessons. Nevertheless, overall, of the lessons that teachers created, many research-based instructional features *were still absent*. Specifically for writing instruction, Spear-Swerling and Zibulsky found that basic writing skills instruction and writing assessment were limited or nonexistent in the majority of

the teachers' instructional plans despite the importance of early writing instruction (e.g., Berninger, 2009). Thus, there is a need for continued in-service teacher professional development and the implementation of research-based curriculums in schools (Spear-Swerling & Zibulsky, 2014).

Coaching and Fidelity of Implementation

To support teachers in developing and sustaining the necessary knowledge and skills required to successfully implement a new practice, such as DBI, within their classrooms, professional development training coupled with ongoing coaching shows promise of effectiveness (see Kraft, Blazar, & Hogan, 2018 for a meta-analysis). In a study assessing three models of professional development intended to improve teachers' reading instruction (i.e., professional development alone, professional development with teacher self-evaluation, and combined professional development, teacher self-evaluation, coaching and collaboration), Carlisle, Cortina, and Katz (2011) found that professional development that included coaching, collaboration, and a way for teachers to evaluate their teaching led to better alignment of classroom instructional time with research-based practices. Furthermore, teachers in the other two conditions showed comparable increases in their knowledge of reading instruction but little to no changes to their actual instruction. This outcome is likely because teachers typically require more than increased knowledge to update their instructional practices (e.g., Desimone, 2002). Support for implementation of knowledge learned during professional development by an instructional coach may be necessary (see Kretlow & Bartholomew, 2010 for a review).

Kretlow, Wood, and Cooke (2011) and Kretlow, Cooke, and Wood (2012) found that training alone (i.e., increased teacher knowledge) was insufficient to increase

teachers' correct use of research-based practices consistently; individualized coaching was required for such practices to be accurately implemented. The National Center for Systematic Improvement (n.d.) states the purpose of instructional coaching is to support teachers in the implementation of new skills or practices that have evidence of high effectiveness, with fidelity, for the purpose of improving student outcomes (Kretlow & Bartholomew, 2010; Snyder, Hemmeter, & Fox, 2015). In particular, fidelity of implementation (also referred to as treatment fidelity, treatment integrity, or procedural reliability; Gresham, MacMillian, Beebe-Frankenberger, & Bocian, 2000) indicates the extent to which key features of an intervention are implemented as intended (Gersten et al., 2005). Fidelity of implementation is a critical concern among researchers and practitioners alike. Unfortunately, few empirical studies of coaching have included outcome measures of student achievement (Kretlow & Bartholomew, 2010; Marsh, McCombs, & Martorell, 2010). However, evidence supports the notion that student growth on an outcome can be largely and positively affected by teachers' increased use of evidence-based practices with high fidelity of implementation, and that these teacher behaviors can be supported through coaching (Kretlow & Bartholomew, 2010).

Whereas evidence supports the use of coaching, more research is needed to understand how to optimize its efficacy and efficiency. With the ultimate goal always being increased student achievement (Kretlow & Bartholomew, 2010; Snyder et al., 2015), focusing coaching sessions to be optimally effective and efficient is important given the multiple responsibilities and high demands of being a teacher. While previous studies have examined the relation between teacher factors and increased student achievement, many of these studies have focused on factors such as teacher level of

education and certification(s) held (see Wayne & Youngs, 2003 for a review). However, such factors are not amenable to the types of changes that coaching can facilitate.

Therefore, more information is needed to better understand the strength of the relation between specific teacher factors that might be more readily influenced by coaching (e.g., teacher knowledge, skills, fidelity) and student outcomes so that coaching sessions can target the most relevant skills. The present study adds to this literature by addressing the relation between teacher knowledge, skills, and fidelity to student growth. Specifically, the current study assesses teacher factors (i.e., DBI knowledge and skills; fidelity of implementation of DBI components including writing instruction, CBM administration, and instructional decision-making) that can be directly addressed during instructional coaching and that may influence the writing growth of students with severe learning needs within the DBI framework. Therefore, this study should be viewed as an exploratory investigation intended to inform future research addressing how to optimize coaching supports to improve teaching and result in greater outcomes in student writing growth.

Theory of Change

In the present study, teachers were provided professional development through the implementation of Data-Based Instruction: Tools, Learning, and Collaborative Supports (DBI-TLC; Lembke et al., 2018) to support them in learning about and implementing DBI for students at-risk for or identified with disabilities that affect their early writing skills. Through DBI-TLC, teachers received professional development, ongoing coaching, and materials for assessment and instruction. For the purposes of the current study, an eight-step approach to DBI was adopted, consisting of the following

steps used in an iterative manner: (a) determine the student's present level of performance, (b) set a long-term goal that is both achievable and ambitious, (c) deliver high-quality instruction with fidelity that is matched to student need, (d) frequently monitor student progress toward the goal, (e) gauge instructional effectiveness and student progress by applying decision rules, (f) create hypotheses about student progress, (g) test the hypotheses to individualize instruction by making an instructional change, and (h) repeat as necessary (Lembke et al., 2018; McMaster et al., 2018).

In light of the reviewed research, the following theory of change (Figure 1) was used. In the larger study from which the current data are drawn (McMaster et al., 2018), the theory of change included that teacher participation in DBI-TLC would additionally lead to improvements in their self-efficacy, leading to increased fidelity, and ultimately, increased student achievement. However, in the current study, teachers' self-efficacy was not included for two reasons. First, examining teacher self-efficacy is beyond the scope of this study since the focus is on teacher factors related to teacher knowledge and implementation—factors that might be more directly impacted through coaching and were the focus of coaching sessions during the randomized control trial (RCT). Second, the small sample size, specifically regarding the number of teachers, did not allow for all available teacher factors to be included in the model. Therefore, the theory of change from McMaster and colleagues has been modified for use in the current study and posits that by providing comprehensive professional development with ongoing coaching support, teachers' knowledge and skills related to DBI and early writing instruction would improve, leading to greater fidelity of implementation of DBI components, ultimately leading to improved student outcomes.

Purpose and Research Question

The purpose of this investigation was to explore teacher factors and how they relate to student growth in early writing. In the interest of optimizing coaching to lead to a greater chance of student growth, knowing which malleable teacher factors may be most influential to achieving this end is necessary. The specific research question addressed in this study was: What is the relative strength of the relation between teacher factors (i.e., teachers' DBI knowledge and skills, fidelity of implementation in CBM administration, writing instruction, and decision-making) and growth in students' early writing as measured by CBM-Writing tasks?

Method

All data used in the current study were drawn from a larger study assessing the feasibility and promise of a professional development program designed to support teachers' use of DBI (McMaster et al., 2018). This larger study included a small pretest/posttest RCT group design in which teachers were randomly assigned to treatment (in which they received DBI-TLC and implemented DBI for 20 weeks) or a business-as-usual control group. All teacher participant data included in the current study were from RCT treatment group teachers.

Participants

Participants included 11 elementary special education teachers from two school districts (one urban and one small city; see Table 1 for teacher demographic data) in two Midwestern states and a subset of their students ($n = 31$; see Table 2 for student demographic data). Teacher participants were required to have a minimum of two years of teaching experience and directly provide instruction in early writing to the student

participants. All students were deemed at-risk for or identified with mild to moderate disabilities that affected their writing and subsequently received intervention to improve early writing skills. Students were primarily in Grades 1-3 with some in Grades 4-5. Students were nominated for study participation by their teachers. Following nomination, students were administered CBM-Writing probes: two word dictation and two picture word (described in “Measures” section). The two to three lowest-scoring students from each teacher’s classroom were selected for study participation (see McMaster et al., 2018, for more specifics regarding participant inclusion).

Intervention

Data-Based Instruction: Tools, Learning, & Collaborative Supports. DBI-TLC is a professional development program designed to develop teachers’ knowledge of DBI and support their implementation of DBI within their classrooms for students at-risk for or identified with disabilities that affect their writing. Specifically, during the RCT, researchers provided treatment teachers materials for and instruction on the use of DBI during four full-day workshops. Teachers implemented DBI with bi-weekly coaching support for 20 weeks. The workshops focused on the following topics: (a) CBM administration, scoring, and graphing, (b) selecting and implementing research-based instructional mini-lessons that target the individual needs of the student, and (c) using data to make instructional decisions. This knowledge base became the foundation for teachers to implement the DBI process, with coaching support, in their classrooms. The researchers encouraged the teachers to deliver individualized mini-lessons at least three times per week for 20 or 30 minute intervention sessions; however, intervention dosage and duration was ultimately determined by each teacher based on student need. The

results of the RCT pilot study from which these data were drawn showed that students of DBI-TLC treatment teachers improved in their writing performance (effect sizes of 0.23 to 0.40) as measured by CBM-Writing tasks (McMaster et al., 2018).

Coaching. The purpose of the coaching sessions was to support teachers in their implementation of DBI. All participating teachers received one-on-one bi-weekly coaching throughout the duration of the study that averaged 40 minutes per session ($SD=16.10$). Each coaching session consisted of the following activities: (a) celebration and commiseration (to build relationships), (b) summarization of the previous meeting, (c) identification of objectives for the current meeting, (d) viewing of performance measures, (e) summarization of the meeting, (f) planning for the next meeting, and (g) identification of tasks to be completed by the coach and teacher prior to the next meeting. Additional coaching session topics included looking at permanent products regarding: (a) teachers' CBM administration, CBM scoring reliability, and CBM graphing, (b) instructional dosage log, (c) writing instructional plan creation, administration, and fidelity, (d) and looking at individual student progress monitoring graphs to assess growth and make instructional decisions.

Measures

Student outcome. Teachers used one of three CBM-Writing tasks to track student progress in early writing skill development. Students were administered either CBM-Writing word dictation, picture-word, or story prompts depending on their specific writing needs and level of performance. To enable comparisons across task types, CBM-Writing scores were converted to scale scores for the purpose of this study. This procedure is described in more detail below under "Data Analysis."

Each CBM-Writing task was either administered individually (word dictation) or group-administered (picture-word and story prompt). Students were given three min to complete the probes, which were given weekly during the course of the study by their teacher. Student CBM-Writing samples were scored using quantitative indices which are described below in more detail for each measure. These measures have empirical evidence supporting their use with early writers (McMaster et al., 2011) and, when administered weekly, have been shown to be sensitive to student writing growth within eight weeks (Hampton & Lembke, 2016; McMaster, Du, Yeo, Deno, Parker, & Ellis, 2011). Further psychometric information is detailed below.

CBM-Writing word dictation. This progress monitoring task is designed to measure writing skills at the word-level. To administer, a list of words is read aloud, with one repeat, that contains specific spelling patterns (taken from the Common Core State Standards, National Governors' Association, 2010). Students write the dictated words. Written responses were scored for the total number of words written, words spelled correctly, correct letter sequences (i.e., any two sequential letters in a word that are appropriately placed to correctly spell the word), and correct minus incorrect letter sequences. Alternate form reliability of this measure for grades 1-3 has been found to be $r = .89$ to $.95$ (Lembke, Carlisle, & Poch, 2015; Lembke, Deno, & Hall, 2003). For the current sample, test-retest reliability coefficients were calculated to be $r = .94$ to $.96$ (pretest) to $r = .92$ to $.96$ (posttest) (McMaster et al., 2018).

CBM-Writing picture-word. This progress monitoring task is designed to measure writing skills at the sentence-level. To administer, students are given writing prompts which are a series of words accompanied by pictures. Students are given a

practice item prior to beginning. Written responses were scored for total words written, words spelled correctly, correct word sequences (i.e., any two sequential words that are spelled, punctuated, and used correctly within the context of the writing), and correct minus incorrect word sequences. Alternate form reliability for this measure for grades 1-3 has been found to be $r = .50$ to $.60$ (Lembke et al., 2015; McMaster, Du, & Pétursdóttir, 2009). For the current sample, test-retest reliability coefficients were calculated to be $r = .67$ to $.91$ (pretest) to $r = .85$ to $.90$ (posttest) (McMaster et al., 2018).

CBM-Writing story prompt. This progress monitoring task is designed to measure writing skills at the paragraph-level. To administer, students are given a writing prompt which is a sentence or the beginning of a sentence, written in age-appropriate language, structure, and content. Students are given 30 seconds to plan their writing before they begin to write their story. Written responses were scored for total words written, words spelled correctly, correct word sequences, and correct minus incorrect word sequences. Alternate form reliability for this measure for grades 1-3 has been found to be $r = .74$ to $.88$ (Lembke et al., 2015). For the current sample, test-retest reliability coefficients were calculated to be $r = .71$ to $.89$ (administered only at posttest) (McMaster et al., 2018).

Teacher factors. Teachers were pre- and posttested on their DBI knowledge and skills as well as assessed in their fidelity of components of DBI implementation. As previously stated, sample size limitations did not allow for all possible teacher factors measured during the RCT to be included. Thus, teachers' posttest scores on DBI knowledge and skills, and fidelity for implementing three key components of the DBI framework: writing instruction, CBM administration, and decision-making, were entered into the analysis. Given that these four teacher factors could potentially be directly

affected through coaching, an understanding of the extent to which they are related to increased student achievement is important to optimize coaching effectiveness.

DBI knowledge and skills. Teachers' DBI knowledge and skills were measured both pre- and post-intervention by a 40-question multiple choice assessment that was developed for use in the RCT (for more specifics, see McMaster et al., 2018). This assessment is designed to gauge teachers' knowledge of the purpose of DBI. Specifically, questions target the DBI framework, progress monitoring, development and instruction of writing, CBM administration and scoring, and using CBM data within the DBI framework to make appropriate and timely instructional decisions for the individual student. For the current sample, Cronbach's α of .58 (pretest) to .78 (posttest) were calculated (McMaster et al., 2018). Only teachers' post-intervention scores (total correct) were used in the current analysis.

Fidelity measures. Fidelity of implementation was measured on three key components to the DBI framework: CBM administration, writing instruction, and decision-making (see Appendix A for fidelity measures). Throughout the 20 weeks of DBI implementation, one or two fidelity checks were performed per teacher in each area by the co-principle investigators (McMaster et al., 2018). For the current analysis, each teacher's average fidelity was used by taking the mean for each fidelity measure observation, if more than one observation had been completed. For each fidelity of implementation area, McMaster and colleagues created a checklist that entailed the essential components of that area and were scored based on if the specific behavior was observed during the observation period. Fidelity measures were modeled after the

Accuracy of Implementation Rating Scales (AIRS; L. S. Fuchs et al., 1984) which were created for the purpose of assessing DBI fidelity.

The CBM fidelity checklist measured CBM administration, scoring, and graphing. The writing instruction fidelity checklist measured key instructional components such as motivation, modeling, guided practice, and independent practice. Teachers delivered instruction by following Writing Instructional Plans (WIP; McMaster et al., 2018) which are comprised of research-based early writing mini-lessons. Teachers were taught to use the Simple View of Writing (Berninger et al., 2002) framework when planning a WIP, which allows for them to piece together an instructional plan that covers the specific writing needs of their individual students. The decision-making fidelity checklist measured teachers' use of DBI decision rules to make a timely (i.e., made after six to eight data points were collected) and appropriate (i.e., aligned with student data) instructional decision (i.e., raise the goal, modify instruction, keep instruction as-is).

Data Analysis

For the purpose of this study, scale scores were calculated for all three CBM-Writing tasks, maintaining a normal distribution and resulting in a mean of 100, standard deviation of 15. To create the scale scores, unpublished benchmarking data (Lembke et al., 2015) on 603 students in grades one through three were used. Means and *SDs* were calculated on all three CBM-Writing tasks that were then linearly transformed to set the mean at 100 and *SD* at 15. These results were used as the template to then convert the data used in the current study to scale scores (e.g., if the CBM picture-word benchmarking mean was 10 and the *SD* was 2.5, then a score of 10 becomes 100 and a

score of 12.5 becomes 115). This conversion allowed for comparisons across measures given that teachers used different CBM-Writing tasks for different students.

Given the nested structure of the data (students within teachers), a hierarchical linear model (HLM; Raudenbush & Bryk, 2002) would have been the ideal way to model these data. However, the small sample size did not allow for HLM. Instead, a multiple regression analysis was performed. Linear regression assumptions of linearity, independence, normality, and homogeneity of variance were assessed and deemed to be met. The weeks of DBI intervention students received ($n = 20$) (*Weeks DBI*), teacher posttest DBI knowledge & skills score (*Post K&S*), teacher writing instruction fidelity score (*Write Fid*), teacher CBM-Writing administration fidelity score (*CBM Fid*), and teacher decision-making fidelity score (*DM Fid*) were regressed on students' weekly CBM-Writing scale scores (*CBM*). Given that the research question focused on the extent to which teacher factors related to student early writing growth, all predictors were entered into the model at once.

$$CBM = \beta_0 + \beta_1(Weeks\ DBI) + \beta_2(Post\ K\&S) + \beta_3(Write\ Fid) + \beta_4(CBM\ Fid) + \beta_5(DM\ Fid) + \epsilon$$

Results

While complete data were available for all 11 teachers in the study, resulting in no teacher attrition, missing student data due to absences or moving resulted in the original 36 students of treatment teachers being reduced to a total of 31 students included in the final analysis.

Fidelity observations revealed that DBI teachers reliably administered CBM-Writing used for progress monitoring with a mean of 84% accuracy ($SD = 14.7\%$) and

95% mean interrater agreement in scoring, writing intervention with 79% accuracy ($SD = 14\%$), and fidelity of overall decision-making was 52% ($SD = 38\%$). See descriptive statistics on teacher measures in Table 3. Results of the multiple regression analysis showed the model accounted for about 29% of the overall variance in student growth ($R^2 = 0.288$). See regression results in Table 4. Specifically, of the predictors entered into the model, main effects for the number of weeks a student received DBI intervention ($\beta = 0.41, p < .001$) and their teacher's posttest DBI knowledge and skills assessment score ($\beta = 4.84, p < .003$) were statistically significant predictors of the student writing outcome. No measures of fidelity significantly predicted the student writing outcome.

Discussion

The purpose of this investigation was to explore the relative strength of the relation between teacher factors (i.e., teachers' DBI knowledge and skills, fidelity of implementation in CBM administration, writing instruction, and decision-making) and student growth in early writing. To help support teachers to be successful in implementing newly learned instructional strategies that have evidence of leading to improved student outcomes, it is essential that coaches are effective and efficient in their support. In other words, to optimize coaching, the identification of malleable teacher factors which, if addressed during coaching, are related to the greatest amount of student growth is needed.

Results from the analysis that regressed teacher factors on student CBM-Writing scores over a 20-week period suggest a significant relation between teacher knowledge and skills of the DBI framework and growth in early writing for students with intensive needs. Specifically, higher teacher knowledge and skills was related to greater student

growth. This finding aligns with previous research showing the efficacy of DBI to improve student growth (Jung et al., 2018; Stecker et al., 2005), the positive effect of coaching on student achievement (Kraft et al., 2018), and the benefit of teachers' increased knowledge of evidence-based practices, supported through coaching, on student growth (Kretlow & Bartholomew, 2010). Moreover, these results appear to support our theory of change that there is a progression of teacher skill acquisition that leads to improved student outcomes.

Although our theory of change suggests implementation with fidelity should affect student growth, the results obtained from this investigation suggest that fidelity may be relatively less important to student growth in early writing when including weeks of instruction and teacher posttest DBI knowledge and skills in the model. In other words, the results of the model, considered within the context of our theory of change, suggest that teacher knowledge and skills play a stronger role in student growth in early writing than fidelity of implementation. However, these results should be interpreted with caution for several reasons.

First, teachers implemented the intervention for a total of 20 weeks, which may not have been a sufficient amount of time for meaningful change to happen across all areas within our theory of change. In other words, while teachers' DBI knowledge and skills improved from pre- to posttest and was substantially higher than that of control teachers (Hedge's $g = 2.88$; McMaster et al., 2018), there may have been an insufficient amount of time for this increase in knowledge and skills to influence fidelity, suggesting a progressive nature to skill development amongst the specific skills measured. Other researchers have found that a large amount of professional development and instructional

practice appears to be needed (i.e., 80 or more hours) before a teacher is likely to appropriately implement a new skill (Corcoran, McVay, & Riordan, 2003).

Second, it could be that the theory of change proposed is incorrect. Perhaps improving teachers' knowledge and skills of DBI coupled with coaching is enough, in certain circumstances, to lead to student growth with sufficient improvements to fidelity possibly serving as an additional boost to student learning. Given that many teachers report limited pre-service teacher education meant to prepare them to instruct students in writing and that observational studies have suggested that minimal time is devoted to writing instruction and practice in elementary grades (Cutler & Graham, 2008), it is conceivable that the increased teacher knowledge and skills of DBI for early writing indeed did lead to improved student outcomes, in the absence of an effect of fidelity. This could be because the increased knowledge and skills led to the teachers teaching necessary basic writing skills to their students, which may not have been happening prior to the study. Evidence of this possibility can be found from data collected during the RCT from which the data for the current study were taken where McMaster and colleagues (2018) conducted observations of the control group and found that control teachers typically instructed writing for 20 – 40 minutes per day but that their writing instruction rarely included skills in basic writing.

Last, it is possible that the measures used to quantify fidelity of implementation may not have been sensitive enough to teacher growth or may not have adequately captured fidelity, effectively not showing any relation, should one exist, between fidelity and student growth in early writing. Particularly relevant to the current study are the issues surrounding the measurement of fidelity of implementation for an intervention that

is meant to be individualized and intensified (see Sanetti & Kratochwill, 2009 for a discussion) such as was the case with DBI-TLC. Although high adherence to fidelity has been shown to increase student outcomes (O'Donnell, 2008), for students who most struggle, a lack of appropriate individualization of instruction could potentially stifle student growth (e.g., Wanzek & Vaughn, 2009). At the core of DBI is the use of instructional modifications to improve student outcomes that are determined through the use of data (Deno & Mirkin, 1977; Jung et al., 2018). Therefore, modifications to the base instructional plan are an expectation. Thus, when measuring fidelity of *intensive* intervention, strict adherence to a general checklist of instructional components is likely insufficient and other components of fidelity should be considered (Johnson & McMaster, 2013; Sanetti & Kratochwill, 2009). One such component may be student response to and engagement with the instruction (O'Donnell, 2008; Sanetti & Kratochwill, 2009). A further discussion of how these considerations impacted post hoc changes to our writing instruction fidelity measure can be found under section “writing instruction fidelity measure modification.”

Of course, all the above explanations are somewhat speculative and require further research to answer more conclusively.

Limitations and Future Research

Limitations of the current study largely center on its exploratory nature. In particular, the sample size of teachers and students obtained was insufficient to construct an appropriate statistical model that would account for the nested structure of the data. Given that a multiple regression model was fit instead of an HLM, variance specific to the teacher or student levels could not be parsed. Relatedly, although it was outside the

scope of the current investigation, another limitation of this study is that not all possible teacher-level factors from the theory of change used during the RCT (McMaster et al., 2018), namely teacher self-efficacy, were included in this study. Future research should include a broader range of teacher factors, such as self-efficacy, to address how these factors may be related to student outcomes. Finally, the adequate measurement of fidelity is a limitation given that some fidelity measures, especially for writing instruction, appeared to not be sensitive to intensive intervention as indicated by the fact that the fidelity measures were used to monitor treatment teachers and control teachers during the pilot study of DBI-TLC but failed to differentiate between the two groups (Lembke et al., 2018). In other words, this suggests that the fidelity measures appeared to fail to capture possible nuances of *intensive* intervention.

As a result of the current study, important questions arise that require future investigation. For instance, future research should further explore the relation between teacher factors, both those investigated here and others, and how they are related to and may impact growth in early writing for students who most struggle. Given empirical support that high implementation fidelity is related to improved student outcomes (Kretlow & Bartholomew, 2010), the results of the current analysis beg the question of whether fidelity of implementation was measured in a sensitive enough manner to validly capture fidelity of *intensive* intervention. Put differently, perhaps the writing instructional fidelity measure used was not sensitive enough to capture important nuances to instruction that may be related to student growth. Specifically, given that the purpose of DBI is to support teachers in taking a scientific approach to their teaching by systematically gathering data and making instructional decisions to effectively intensify

and individualize instruction, perhaps the current measure of writing instructional fidelity captured principles of good instruction but not necessarily *intensive* instruction, as evidenced by the inability of this measure to distinguish between treatment and control teachers during a pilot study of DBI-TLC (Lembke et al., 2018) where presumably the treatment teachers were delivering more highly intensified instruction (i.e., through DBI) than controls. Thus, we revised the writing instruction fidelity observation tool to address this need. Regarding the unexpected results suggesting no relation between fidelity of writing instruction, CBM administration, and DBI decision-making, further research is also needed to address how to more adequately measure fidelity of implementation for intensified interventions, such as DBI, and what the important aspects of an intensive intervention are that set it apart from a non-intensive intervention.

In an effort to begin to address the question regarding how to more adequately measure fidelity of intensified interventions, a new fidelity form was created in the hopes of better capturing fidelity of writing instruction within the DBI context (see Appendix B). Thus, future research will be needed to determine adequacy of this new fidelity measure.

Writing Instruction Fidelity Measure Modifications

It was suggested by the author and members of the DBI-TLC research team, through lab discussions and looking to the literature, that a key component that sets *intensive* instruction apart from generally good instruction which therefore should be captured with the fidelity tool is the dynamic response between the teacher and the student. In other words, how do students respond to instruction delivered by the teacher and what does the teacher do in response to the student. Furthermore, this element is seen

as an important part of the implementation of the current intervention because DBI is focused on the individual learner and thus, a key factor is the teacher's response to the individual learner based on how the learner is responding during instruction. For this element to be captured with a fidelity of implementation measure, it is necessary to not only observe and quantify teacher behaviors, but student behaviors, as well. Specifically, an addition was made to the writing instructional fidelity form to focus on the entire classroom of students to measure the extent to which the lesson appears to be adequately paced for the majority of the students. Also, an addition was made to focus on a randomly selected individual student for each mini-lesson to measure how the student responds to the teacher's prompts, if the student receives modeling, guided practice, and independent practice that appears to be sufficient for that student, and specific feedback the student receives. In an attempt to further increase the sensitivity of the measure to *intensive* intervention and assist with reliability between observers, an effort was made to increase the specificity and operational wording used to describe key behaviors.

The revised tool contains sections focused on the lesson set-up, teacher monitoring, motivational components, the classroom environment, and both teacher and student-level observations to be performed during each mini-lesson activity within a WIP. Each behavior measured on the fidelity form is scored on a three-point scale with more points indicating higher fidelity. Some behaviors, however, are scored dichotomously (i.e., full or no points) because the behavior either happens or it does not happen (e.g., "Intervention is targeted to specific student needs which have been identified through assessment data."). The fidelity of implementation score is represented as a proportion of points earned over possible points.

A comparison of the revised form to guidelines provided in the *DBI Implementation Rubric* (National Center on Intensive Intervention, n.d.) shows consistency with an emphasis on intervention aligning to individual student needs, qualitative and quantitative changes to instruction being made based on student needs, and monitoring fidelity of implementation of intensive intervention adequately—which hopefully the revised form does better than the previous form. However, future research is needed to measure the relative sensitivity of the newly revised writing instructional fidelity form in comparison to the sensitivity to measure intensive intervention with the fidelity form used in the current study.

Conclusion

Many students struggle to learn to write and require intensive, individualized instruction to progress in their skills. DBI is a systematic framework that helps teachers gather data to make informed, instructional decisions to intensify and individualize their instruction. Therefore, supporting teachers' implementation of DBI is important (e.g., Jung et al., 2018). Effectiveness and efficiency with coaching is essential to optimize the support provided to teachers and, in turn, optimize student growth. But in order to be effective and efficient in supporting teachers, coaches must know which specific teacher factors are related to greater student growth in early writing. While the results of the current study are exploratory, they provide insight into the importance of supporting teachers' understanding of the DBI framework to support student growth in early writing and suggest the need for careful considerations to be made when measuring fidelity of *intensive* intervention.

Figure 1. Theory of change.

Table 1

Teacher Demographics

	DBI-TLC Teachers (<i>n</i> = 11)
Gender	
Female	11 (100%)
Male	0 (0%)
Ethnicity	
White/European American	11 (100%)
Age	
20-29	2 (18%)
30-39	3 (27%)
40-49	5 (45%)
50-59	1 (9%)
Highest Degree	
Bachelor's	4 (36%)
Master's	3 (27%)
Master's + Coursework	4 (36%)
Current Job Title	
Special Education Teacher	10 (90%)
	-
	<i>M (Range)</i>
Years teaching special education	9.68 (1-22yrs)

Note. Due to rounding, percentages may not sum to 100.

Table 2

Student Demographics

	DBI-TLC Students (<i>n</i> = 31)
Gender	
Female	17 (55%)
Male	14 (45%)
Ethnicity	
Black/African American	4 (13%)
Hispanic/Latino(a) American	2 (6%)
White/European American	22 (71%)
Multiracial	3 (10%)
Free/Reduced Lunch	21 (68%)
English Language Learners	6 (19%)
IEP/Special Education	30 (97%)
Special Education Category	
Autism	8 (26%)
Emotional/Behavioral Disorder	1 (3%)
Learning Disability	8 (26%)
Language Impairment	5 (16%)
Hearing Impairment	1 (3%)
Other Health Disability	4 (13%)
Needing Alternative	3 (10%)
Programming	
	<hr/> <i>M (SD)</i> <hr/>
Age	9.12 (1.41)

Note. Due to rounding, percentages may not sum to 100.

Table 3

Descriptive Statistics for Teacher Variables

	<i>M (SD)</i>
Post K&S	32 (2.2)
Write Fid	79% (14%)
CBM Fid	84% (14.7%)
DM Fid	52% (38%)

Note. Post K&S is teacher posttest score on the DBI knowledge and skills assessment. Write Fid is teacher writing instructional fidelity score. CBM Fid is teacher fidelity score on CBM administration. DM Fid is teacher fidelity score of decision-making that is appropriate and timely based on student data.

Table 4

Regression Output for Teacher Factors Regressed on Student CBM-Writing

	β	SE	p -value
Intercept	-30.47	51.23	.55
Weeks DBI	0.409	0.068	< .001
Post K&S	4.837	1.598	.003
Write Fid	-0.858	0.759	.26
CBM Fid	0.000	0.046	1.00
DM Fid	0.331	0.779	.67

Note. Model-level statistics: $F(5, 339) = 27.46$, $p < .001$, RSE 9.399 on 339 $d.f.$, $R^2 = 0.29$

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**Accuracy of Implementation Rating Scale (AIRS)--
CBM-W: Picture Word Prompt**

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

Part I. Administering the Assessment. Observe the assessment implementation, 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. Follows the directions in order				
a. Places prompt in front of each student				
b. Presents an example of a Picture-word prompt				
c. Demonstrates how students should complete the entire Picture-word task with the sample copy				
d. Reminds students to do their best work				
e. Demonstrates how to deal with spelling difficulties while taking test				
f. Reads each word on the Picture-word task				
g. Prompts students to continue working until the timer rings, if necessary				
3. Overall demonstration skills:				
a. Reads directions accurately				
b. Demonstrates by pointing when appropriate				
c. Pauses for questions				
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.”				
e. Marks administrator copy as needed				

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

	Yes 1	No 0	N/A	Observation notes:
<i>Scoring for Words Written</i>				
a. Correctly counts the number of words written				
<i>Scoring for Words Spelled Correctly</i>				
a. Misspellings are correctly underlined in red				
b. Correctly counts the number of words spelled correctly (regardless of context)				
<i>Scoring for Correct Word Sequences (CWS)</i>				
a. Blue upper carets are used to indicate correct word sequences				
b. Red lower carets are used to indicate incorrect word sequences				
c. CWS are counted accurately				
d. Incorrect word sequences are counted accurately				

Part III. Documenting Assessment Outcomes. Inspect CBM graphs.

	Yes 1	No 0	N/A	Observation notes:
<i>Graph Set-up</i>				
a. Dates are correctly labeled on X-axis				
b. Name of measure and scoring method is correctly labeled on Y-axis				
c. Data points are correctly plotted				
d. A vertical line is drawn to separate baseline data from progress data				
<i>Goal Line</i>				
a. Long-range goal is correctly calculated				
b. A goal line is drawn from baseline to the long-range goal				

Accuracy of Implementation Rating Scale (AIRS)-- Decision-Making

Implementer:	Observer/rater:
Student:	Date:

Decision-Making. Inspect the implementer's Decision Log(s) and compare to student graphs and/or other data provided.

	Yes 1	No 0	N/A	Notes:
<i>Use of Decision Rules</i>				
a. Teacher made a <i>timely</i> decision (i.e., 6-8 data points after baseline or after 4-6 data points after initial decision).				
b. Teacher made an <i>appropriate</i> decision using the following decision rules: <ul style="list-style-type: none"> ☐ Keep instruction as-is (trend line is in line with goal line or data are highly variable) ☐ Raise goal (trend line is above goal line) ☐ Change instruction (trend line is below goals line) ☐ Other reasonable rationale (describe in Notes) 				
c. Decision is noted on graph: <ul style="list-style-type: none"> ☐ Goal line is adjusted (if progress exceeds goal) ☐ Vertical line inserted (if instructional change made) 				
d. Teacher noted a specific type of instructional change.				

Accuracy of Implementation Rating Scale (AIRS)— Writing Instruction

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

Implementing Writing Instruction. Observe the instruction implementation, 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:
The objective(s)/learning target and a rationale for why the skill is being taught is provided.				
A motivational strategy or systematic reinforcement is in place.				
A warm-up activity is implemented, and/or content from previous day is reviewed.				
Activity 1 (describe):				
• Implemented for the specified time.				
• Sufficient modeling is provided.				
• Sufficient guided practice is provided.				
• Sufficient reinforcement is provided for correct responses.				
• Sufficient independent practice is provided.				
Activity 2 (describe):				
• Implemented for the specified time.				
• Sufficient modeling is provided.				
• Sufficient guided practice is provided.				
• Sufficient reinforcement is provided for correct responses.				
• Sufficient independent practice is provided.				
Activity 3 (describe):				
• Implemented for the specified time.				
• Sufficient modeling is provided.				
• Sufficient guided practice is provided.				
• Sufficient reinforcement is provided for correct responses.				

<ul style="list-style-type: none"> Sufficient independent practice is provided. 				
The content is reviewed through a lesson wrap up.				
An extension for the lesson content for that day is provided.				

Fidelity Tool Writing Instruction

Implementer:	Observer/rater:
Date:	Number of students: Target student initials:
Start time:	End time:

Implementing Writing Instruction. Observe the instruction implementation, complete the checklist to the extent that the components were included, and write detailed notes regarding other components observed.

Preparation: Gather the following information from the teacher *prior* to the observation.

- ☐ Get a copy of the WIP/lesson plan the teacher using.
- ☐ Which mini-lesson(s) does the teacher plan to implement during the session? Name below in Activities and have a copy on hand. Note: if more than 3 activities, document first three.
- ☐ Review the planned mini-lesson(s) and fidelity checklist(s) ahead of time.
- ☐ What proportion of the WIP does the teacher plan to complete?

Codes: Observe and write the corresponding number in the appropriate column. For some items, “NA” (not applicable) might be necessary. Try to avoid “NA,” but if absolutely needed, just write it in the boxes.

*For single event observations:

2=In-place and effective

1=Partially in-place/In-place and ineffective

0=Not in-place

*For reoccurring event observations:

2=All or almost all of observed instances

1=Sometimes or not consistently

0=Rarely or never

Component	2	1	0	Observation notes:	
Lesson Set-Up					
<i>Note – focus observations for this section on the entire group</i>					
*All materials are ready at the start of the lesson.					
*The teacher uses a systematic and effective beginning to the lesson. This must take less than 2 min total to receive a “2.” Longer receives a “1.”					
*Students are informed of lesson objective(s)/ purpose in clear, kid-friendly language.					
Monitoring, Motivation, & Environment (this can be completed at the end of the observation)					
<i>Note – focus observations for this section on the entire group</i>					
*The instructional space is organized such that the teacher has easy access to each student and all students have direct access to instruction (e.g., can easily see/hear teacher).					

A systematic reinforcement/motivation system is <i>used</i> that rewards effortful attempts, correct responses, and positive behavior.				
Teacher corrects and does not reinforce inappropriate behavior. This may include planned ignoring.				
The teacher uses a signal or prompt to gain student attention in an effective and efficient manner.				
Subtotal for set-up, monitoring & motivation (total points earned/possible points)	(_____/_____) = _____			
Component	2	1	0	Observation notes:
Activity 1 (name of mini lesson):				
<i>Start time:</i> _____ <i>End time:</i> _____				
A1 Teacher observation				
<i>Note – focus observations for this section on the entire group</i>				
The teacher actively engages students in the lesson (e.g., students write, respond, create, question). At least half of the students must be on-task and attentive to receive a “2.”				
The lesson is briskly paced without being rushed (i.e., most students appear to be keeping up with the lesson).				
The entire planned activity was completed in the allotted time (according to teacher’s plan).				
Teacher implemented all items on mini-lesson fidelity checklist.				
A1 Individual student/teacher level observation				
<i>Note – focus observations for this section on one target student (initials: _____)</i>				
Student responds to teacher prompts (e.g., via oral or written response). Should be within 3-5 seconds to receive a “2.”				
Student is engaged in the activity (e.g., student appears to be continuously following along and completing tasks with few or no instances of sustained off-task behavior).				
Student receives sufficient modeling of skill; the teacher <i>explicitly</i> and <i>systematically</i> teaches a specific skill.				
Student receives sufficient guided practice with skill; opportunity is provided for student to practice the specific skill with teacher/peer assistance.				
Student receives sufficient independent practice with skill; opportunity is provided for student to practice the specific skill on his/her own.				

Frequent and <i>specific</i> feedback is provided to student throughout the lesson; errors are corrected. To earn a “2,” at least 2 instances of direct, individual feedback is needed.				
Subtotal for Activity 1 (total points earned/possible points)	(_____/_____) = _____			

Component	2	1	0	Observation notes:
Activity 2 (name of mini lesson):				
<i>Start time:</i> _____ <i>End time:</i> _____				
A2 Teacher observation				
<i>Note – focus observations for this section on the entire group</i>				
*Transition between activities is brief (i.e., 30 seconds or less). However, if transition takes longer due to teacher reviewing activity and more than half of the students are attentive, award a “2.”				
The teacher actively engages students in the lesson (e.g., students write, respond, create, question). At least half of the students must be on-task and attentive to receive a “2.”				
The lesson is briskly paced without being rushed (i.e., most students appear to be keeping up with the lesson).				
The entire planned activity was completed in the allotted time (according to teacher’s plan).				
Teacher implemented all items on mini-lesson fidelity checklist.				
A2 Individual student/teacher level observation				
<i>Note – focus observations for this section on one target student (initials: _____)</i>				
Student responds to teacher prompts (e.g., via oral or written response). Should be within 3-5 seconds to receive a “2.”				
Student is engaged in the activity (e.g., student appears to be continuously following along and completing tasks with few or no instances of sustained off-task behavior).				
Student receives sufficient modeling of skill; the teacher <i>explicitly</i> and <i>systematically</i> teaches a specific skill.				
Student receives sufficient guided practice with skill; opportunity is provided for student to practice the specific skill with teacher/peer assistance.				
Student receives sufficient independent practice with skill; opportunity is provided for student to practice the specific skill on his/her own.				
Frequent and <i>specific</i> feedback is provided to student throughout the lesson; errors are corrected. To earn a “2,” at least 2 instances of direct, individual feedback is needed.				
Subtotal for Activity 2 (total points earned/possible points)	(_____/_____) = _____			

Component	2	1	0	Observation notes:
Activity 3 (name of mini lesson):				
<i>Start time: End time:</i>				
A3 Teacher observation				
<i>Note – focus observations for this section on the entire group</i>				
*Transition between activities is brief (i.e., 30 seconds or less). However, if transition takes longer due to teacher reviewing activity and more than half of the students are attentive, award a “2.”				
The teacher actively engages students in the lesson (e.g., students write, respond, create, question). At least half of the students must be on-task and attentive to receive a “2.”				
The lesson is briskly paced without being rushed (i.e., most students appear to be keeping up with the lesson).				
The entire planned activity was completed in the allotted time (according to teacher’s plan).				
Teacher implemented all items on mini-lesson fidelity checklist.				
A3 Individual student/teacher level observation				
<i>Note – focus observations for this section on one target student (initials: _____)</i>				
Student responds to teacher prompts (e.g., via oral or written response). Should be within 3-5 seconds to receive a “2.”				
Student is engaged in the activity (e.g., student appears to be continuously following along and completing tasks with few or no instances of sustained off-task behavior).				
Student receives sufficient modeling of skill; the teacher <i>explicitly</i> and <i>systematically</i> teaches a specific skill.				
Student receives sufficient guided practice with skill; opportunity is provided for student to practice the specific skill with teacher/peer assistance.				
Student receives sufficient independent practice with skill; opportunity is provided for student to practice the specific skill on his/her own.				
Frequent and <i>specific</i> feedback is provided to student throughout the lesson; errors are corrected. To earn a “2,” at least 2 instances of direct, individual feedback is needed.				
Subtotal for Activity 3 (total points earned/possible points)	(_____ / _____) = _____			

Component	2	1	0	Observation notes:
Lesson Wrap-Up				
The content is reviewed through a lesson wrap-up				
Fidelity Score (total points earned/total points possible)	(_____/_____) = _____			

<p style="text-align: center;">Additional Observations and Notes <i>(Anything else to note; for instance, significant disruptions that may have impacted fidelity.)</i></p>