Early Writing Intervention: A Best Evidence Synthesis

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Abstract

The purpose of this best-evidence synthesis was to identify promising interventions that align with a theoretical model of early writing development, targeting three components of early writing: transcription, text generation, and self-regulation. We determined the extent to which these interventions are *effective* for children who struggle with early writing skills, by calculating effect sizes for group and single subject designs, and examined the overall *quality* of the research. Twenty-five studies met inclusion criteria. Among group design studies, mean effects ranged from $g = 0.19$ to 1.17 for measures of writing quantity and from $g = 0.17$ to 0.85 for measures of writing quality. Percentage of all non-overlapping data (PAND) for single subject designs ranged from 83%-100% for measures of writing quantity. Interventions with the strongest evidence of effects *and* highest methodological quality are described in detail. Recommendations for research and practice are provided.

Early Writing Intervention: A Best Evidence Synthesis

Learning to write is critical to students' overall literacy development and success in school (Biancarosa & Snow, 2004). Writing provides students with the means to communicate what they know (Graham & Perin, 2007), is important for integrating knowledge and thinking critically (Shanahan, 2004), and can be a "vehicle for improving reading" (Graham & Hebert, 2010, p. 6). Lack of writing proficiency can have a serious impact on postsecondary and employment opportunities, and overall success in life (Graham & Perin, 2007).

Improving writing outcomes is particularly important for students with or at risk for disabilities (Graham, Harris, & Larsen, 2001). For example, Salahu-Din, Persky, and Miller (2008) found that, nationally, only 6% of 8th-graders with learning disabilities (LD) reached proficiency in writing; 46% were below the basic level. Fortunately, early identification and effective, individualized instruction can prevent long-term negative consequences for many students (Berninger, Nielson, Abbott, Wijsman, & Rasking, 2008).

Given the importance of early intervention, identification and implementation of evidence-based early writing interventions is paramount. Thus, the purpose of this synthesis was to identify early writing interventions for children in primary grades (kindergarten through Grade 3). Below, we describe the conceptual framework that guided our search for early writing interventions, summarize previous relevant reviews, and discuss our approach to identifying interventions with the 'best evidence' of effectiveness in the literature.

Conceptual Framework

Our conceptualization of early writing is based on a theoretical model of early writing derived from the seminal work of Hayes and Flower (1980), who proposed a cognitive model that incorporates three key writing processes: planning, translating, and reviewing/revising.

Whereas this model describes *skilled* writing, researchers (see Berninger, 2009; McCutchen, 2006 for reviews) have demonstrated that two components related to *'translating'* are critical for understanding and assessing writing development in children: *text generation* (selecting words and producing sentences, paragraphs, and longer units of discourse in order to express ideas), and *transcription* (translating words, sentences, and higher levels of discourse into print, which requires handwriting or typing and spelling). Processes related to planning, reviewing, revising, and other self-regulatory skills comprise a third component (Berninger & Amtmann, 2003).

Development within and across each of these components is constrained by cognitive resources (e.g., short-term, long-term, and working memory; Berninger, 2009; McCutchen, 2006). When students struggle with one component of writing (such as handwriting and spelling skills involved in transcription), they have limited resources to devote to other components (such as word selection and sentence construction involved in text generation). Researchers have shown that each of these components is important to the overall quantity and quality of students' writing (e.g., Berninger, 2009; Graham, McKeown, Kiuhara, & Harris, 2012; McCutchen, 2006). Thus, early writing intervention that targets skills within each component is likely needed to improve young children's writing development.

Previous Syntheses

Two recent published reviews have identified writing interventions for students in elementary grades (Graham et al., 2012) and across Grades K-12 (Datchuk & Kubina, 2012). In Graham et al.'s (2012) meta-analysis, 30 of 115 studies addressed interventions for students in Grades 1 through 3. Of these 30 studies, about 27% addressed the use of Self-Regulated Strategy Development (SRSD). Another 27% addressed transcription skills, and the remainder addressed a variety of multi-component, word processing, and peer-mediated interventions. Interventions

that yielded the strongest effects in Grades 1 through 3 included strategy instruction (effect sizes ranged from 0.25 to 1.89), text structure instruction (0.33 to 0.94), teaching transcription skills (0.12 to 2.40), and pre-writing activities (0.56 to 0.88).

Datchuk and Kubina (2012) reviewed strategies for students in grades K-12 at risk for writing difficulties (grades K-4) or with LD (all grades). Of the 19 studies reviewed, 10 included students in grades K-3; these 10 studies addressed handwriting interventions designed to support letter formation (e.g., Graham, Harris, & Fink, 2000) and motor skills, such as hand strength, dexterity, and kinesthetic awareness (e.g., Berninger et al., 2006). Effect sizes ranged from -0.11 3.22 on handwriting outcomes. In 7 of the 10 studies in which effect sizes were calculated, 5 had effect sizes greater than 1. Together with Graham et al. (2012), these reviews indicate that interventions focusing on transcription and self-regulation show promise for young writers.

Quality of the Evidence of Early Writing Interventions

To provide further guidance for research and practice, in the present synthesis we aim to extend the literature in two ways. First, we aim to determine the extent to which early writing interventions in each of the three areas described in our conceptual framework (transcription, text generation, and self-regulation) affect young children's writing composition skills. We focus specifically on writing composition to provide further empirical support for the theoretical importance of each component to overall writing skill, as well as to identify gaps in the literature and directions for further research. To do so, we report the overall effect of each intervention on writing composition *quantity* (amount of writing produced) and *quality*, using effect size estimates for group and single subject designs (described in more detail in Methods).

Second, we aim to identify those interventions with the *best evidence* of effectiveness— that is, those studies that have not only demonstrated strong intervention effects, but have done

so with sufficient internal and external validity—such that practitioners can be confident in selecting interventions from the available options with the greatest likelihood of improving early writing outcomes. To do so, we adopted a *best-evidence synthesis* approach (Slavin, 1986), by combining effect size estimates and strict inclusion criteria (as is done in meta-analysis) with a critical review of substantive features and methodological quality of the available studies (as is done in narrative synthesis). Strict inclusion criteria used in best-evidence synthesis approaches do not guarantee that the research is without flaws, but rather allow for examination of the best evidence *currently available* on a given topic (Slavin, 1986). Thus, we further examined the quality of studies that met inclusion criteria for this review using quality indicators recommended for group experimental and quasi-experimental research (Gersten et al., 2005) and single subject design research (Horner et al., 2005) in special education.

To achieve the above aims, questions guiding this synthesis included: (1) What research-based early writing interventions are *available* in the areas of transcription, text generation, and self-regulation? (2) To what extent are these interventions *effective* for children who experience difficulty with early writing skills? (3) What are the features of exemplary interventions (defined as interventions supported by strong effects and high-quality study design)?

Method

Search Procedure

Studies were identified through a three-stage process. First, we collected references from the two reviews described above (Datchuk & Kubina, 2012, Graham et al., 2012) along with an unpublished review on early writing interventions conducted by one of the current authors (Jung, 2013). Second, we searched four electronic databases (Academic Search Premiere, PsycInfo, Education Full Text, and ERIC) using combinations of terms related to *students with writing*

difficulties ("academic failure" or "at risk" or "disabilities" or "learning dis*" or "writing difficulties" or "basic writing" or "beginning writers" or "early writers") AND *writing composition outcomes* (composing or composition or "compositional fluency" or "compositional quality" or "essay writing" or "paragraph writing" or "writing composition." These terms were combined in separate searches with terms related to *transcription* ("spelling;" "capitalization" or "context free" or "grammar" or "punctuation;" "duplication" or "handwriting" or "legibility" or "letter formation" or "penmanship" or "printing" or "transcription" or "typing" or "keyboarding"), *text generation* ("sentence combining" or "sentence construction" or "sentence diagramming" or "sentence expanding" or "sentence structures" or sentences; "story grammar" or "story structure" or "story writing"), *self-regulation* ("self-regulated" or strategy or "self-regulated strategy development" or "SRSD"), or *writing instruction* more broadly (*writing* paired with "exercises" or "instruction" or "intervention" or "research" or "skills" or "strategies"). Third, we identified studies that met inclusion criteria described below.

Inclusion Criteria

To be included in this review, a study had to meet the following five criteria. First, the study had to involve implementation of a writing intervention in the area of transcription (i.e., a focus on transcribing letters, words, sentences, or longer units of discourse into print, such as handwriting or typing and spelling), text generation (i.e., a focus on translating ideas into words, sentences, or longer units of discourse, such as word selection and sentence or story construction), and/or self-regulation (i.e., a focus on strategies designed to facilitate writers' use of planning, reviewing, revising, and other writing processes).

Second, data collected as part of the study had to be analyzed specifically for students with difficulties or disabilities that related to writing, as defined by the study authors. Third, at

least one dependent measure had to include writing composition *quantity* (as measured by a count related to writing production, timed or untimed, such as the number of words written, number of words spelled correctly, or number of story elements included) and/or quality (as measured by a rating of general or specific aspects of a written composition). Studies that only included dependent measures focusing on transcription skills (such as correctly formed letters in handwriting or words spelled correctly in isolation) were not included, as our primary interest was whether interventions had an effect on the broader construct of writing.

Fourth, the study had to employ an experimental or quasi-experimental design with a control group, or a single-subject design that was set up to establish a functional relation between the independent and dependent variables (thus constituting the best *available* evidence; Slavin, 1986). Fifth, the study had to be published in English in a peer-reviewed journal.

Of the articles included in the three previous reviews, 15 (6 from Datchuk & Kubina, 2012; 7 from Graham et al., 2012; 15 from Jung, 2013) met the above criteria. Some studies from the previous reviews were excluded because they did not meet inclusion criteria (e.g., grade level not met [Berninger et al. 2006, Study 4; Saddler & Graham, 2005], no disability/difficulty information provided [Tracy et al., 2009], or no composition measures used [Berninger et al., 2000, Study 2; Berninger et al., 2006, Studies 2 & 3; Burns, Ganuza, & London, 2009; Mackay et al., 2010; Sudsawad et al., 2002; Zwicker & Hadwin, 2009]).

The database searches yielded an additional 1,925 articles. Duplicates were removed, and the remaining articles were screened by reviewing titles and abstracts (and, when necessary, methods sections) to determine whether they met the five criteria listed above. At the end of this process, 25 articles (including the original 15) met criteria. To determine reliability of the selection process, 10% of the articles identified from the database searches were screened

independently by two authors who were graduate students in special education at the time. The

number of agreements on inclusion and exclusion criteria was divided by the number of

agreements plus disagreements and multiplied by 100. Inter-rater agreement was 96% and 98%

for each rater, respectively. Disagreements were discussed and resolved. In addition, descriptive

information from each report (e.g., sample size, participant demographics) were recorded and

double-checked by two authors to confirm the accuracy of the information reported.

Effect Sizes

Effect sizes were calculated for each study in which sufficient information was provided

(e.g., posttest means and *SD*s). For group design studies, the standardized mean difference

(Hedge's *g*) was calculated by subtracting the posttest mean of the control group from the

posttest mean of the experimental group, dividing by the pooled *SD*, and multiplying by a

conversion factor to address the potential overestimation of effects in studies with small samples

(Borenstein, 2009; Hedges, 1981; Lipsey & Wilson, 2001). Effect sizes, confidence intervals,

and standard errors were calculated for all dependent measures in each study, including

maintenance measures. Effect sizes across multiple subgroups (e.g., SRSD and SRSD + peer

support) were also computed for each dependent measure. Mean effect sizes for composing

measures were computed across subgroups, resulting in one quantity and/or one quality effect

size per study. Maintenance effect sizes were calculated when maintenance data were provided.

Whereas this best-evidence synthesis is not intended to be a comprehensive meta-

analysis, we did calculate mean effect sizes in order to provide an estimate of effects of the

interventions included in this review. Effects sizes across group-design studies were combined

within each area of writing using a random-effects model (Lipsey & Wilson, 2001), providing a

preliminary analysis of intervention effects by area of writing focus. In a random effects model, a

weighted mean is calculated including an unconditional variance component associated with factors beyond sampling error. Though strict criteria for this best-evidence synthesis led to the inclusion of studies with similar characteristics, differences in intervention implementation across studies, as well as significant heterogeneity across effects, support the use of a random-effects model. All calculations for group-design studies were conducted using Comprehensive Meta-Analysis software (Borenstein, Hedges, Higgins, & Rothstein, 2005). A complete list of effect sizes per study can be obtained from the first author.

Effect sizes for single subject design studies were calculated using the percentage of all non-overlapping data (PAND). PAND is computed by identifying the minimum number of data points required to be removed from the baseline, intervention, and maintenance phases to eliminate all overlap between phases. The ratio of the removed data points to the total number of data points equals PAND (Parker, Hagan-Burke, & Vannest, 2007; Parker, Vannest, & Davis, 2011). PAND was translated to Phi and confidence intervals were computed. Phi is a well-established effect size with recommendations for interpretation (Cohen, 1988). When studies reported results from multiple measures, PAND, Phi, and the resulting confidence intervals were reported separately for measures of quantity and quality. Maintenance effects were also calculated when provided. PAND values over 80% and Phi coefficients above 0.70 have been interpreted as strong (Burns & Wagner, 2008; Cohen, 1988; Scruggs & Mastropieri, 1998).

To establish interrater agreement on effect sizes, we randomly selected over 30% of group design ($n = 4$) and single subject design studies ($n = 9$). Two authors checked and recomputed effect sizes. The range of interrater agreement was 92%-100% for group design effect sizes and 78%-80% for single subject design effect sizes. The lower range of interrater

agreement for single subject design effect sizes reflects the difficulty in computing PAND from visual analysis. All disagreements were discussed and resolved.

Quality Indicators

Quality indicators (QIs) were derived from those identified by Gersten et al. (2005) for group experimental or quasi-experimental designs and Horner et al. (2005) for single subject designs. QIs based on those identified by Gersten et al. (2005) as 'essential' or 'desirable' for group designs were examined on four dimensions: participants/setting (comparable across conditions at pre-test, randomly assigned to intervention, attrition described, participant characteristics and critical features of setting clearly described), intervention/comparison (components clearly described, where and for how long implemented, interventionist clearly described, possible confounds accounted for, fidelity described, and nature of control condition described), measures (evidence of reliability and validity; data collectors trained, blind to condition, and equally familiar to treatment and control students; aligned with intervention), and data analysis (linked to research questions and unit of analysis; converge with previous results).

QIs based on those identified by Horner et al. (2005) for single subject designs were examined on five dimensions: participants/setting (subjects have characteristics of interest; characteristics and process for selection are clearly described, critical features of setting are described), dependent variable (quantifiable, valid, measured repeatedly over time, inter-observer agreement established, described with replicable precision, and socially/practically important), independent variable (systematically manipulated, fidelity measured and reported, described with replicable precision, implemented over time by typical interventionists in typical contexts), baseline (provides a stable pattern of responding, described with replicable precision), and design (at least three demonstrations of effect; permits elimination of competing hypotheses; replicated

across participants, settings, or materials). Each study was coded for the presence (1) or absence (0) of each QI, and a percentage of QIs met was calculated for each dimension as well as an overall percentage for the study.

To establish interrater agreement on QIs, approximately 30% of all studies for each research design (group design studies $n = 4$ and single subject design studies $n = 4$) were selected at random. Two authors independently coded two group design and two single subject studies that the other person had initially coded. Interrater agreement was 93% and 96% for the two raters. All disagreements were discussed and resolved.

Exemplary Studies

As a final step, we identified 'exemplary' studies, to narrow the scope of studies that would be described in detail in this review. 'Exemplary' studies were defined as the highest-quality studies that also provide clear evidence of intervention effects. Exemplary studies were identified by applying two criteria: the study had to (a) produce a statistically significant effect size (CI could not include 0) or PAND of 80% or higher on at least one measure of writing composition, and (b) meet at least 85% (all but two) of the quality indicators for group or single-subject designs. These somewhat stringent criteria are not intended to minimize the importance of other high-quality studies with meaningful effects (all are listed in Table 2), but simply to highlight features of the most promising early writing interventions in more detail.

Literature Synthesis

Using the search procedures described above, a total of 25 studies were identified for review. Studies were classified according to their writing focus (transcription, text generation, transcription plus text generation, and text generation plus self-regulation). Table 1 shows the representation of group and single subject design studies, as well as grade levels, across these

four areas (no kindergarten studies were located). Table 2 presents details of each study, including participant characteristics and setting; intervention duration/frequency, implementer, and fidelity; study design; and measures and findings, including dependent variables, effect sizes, and quality indicator ratings. Tables 3 and 4 include all QI ratings for group and single subject design studies, respectively. Below, we summarize major study findings by writing components targeted in the interventions.

Transcription Interventions

Seven transcription intervention studies were identified. Of these, 4 studies (57%) included students with identified disabilities, 3 (43%) reported conducting intervention in school-based settings (the remaining did not specify the setting), and 1 (14%) reported that a classroom teacher led the intervention (researchers or hired tutors implemented intervention in the majority of studies). Intervention sessions lasted from 10 to 30 min, for 10 to 48 sessions. Fidelity, when reported (3 studies, 43%) was generally high (> 90%).

Four transcription studies focused on handwriting. Berninger et al. (1997) examined combinations of motor imitation, visual cues, memory retrieval, and copying. Berninger et al. (2006) combined neurodevelopmental activities (e.g., activities to increase hand strength, dexterity, eye-hand coordination, and motor planning) with handwriting instruction (using visual and verbal modeling). Graham et al. (2000) and Jones and Christensen (1999) examined direct teaching through modeling, guided and independent practice, and fluency-building activities.

Three transcription studies focused on spelling. These studies compared a variety of approaches to spelling instruction in different combinations of letter-sound, onset-rime, and whole word methods (Berninger et al., 1998); alphabet principle and syllabus awareness at the subword (e.g., letter-sound), word, and text levels (Berninger et al., 2000); and activities that

incorporated phonemic awareness with word building, word sorting, word hunting, and word study (Graham, Harris, & Fink-Chorzempa, 2002).

Effectiveness and quality. Across transcription studies (all group designs), effect sizes for composition measures (k =11) ranged broadly: Hedge's g for measures of quantity ranged from 0.20 to 0.92, with an overall mean effect size of g = 0.46 [CI = 0.20, 0.73] (see Table 2 for breakdown by posttest and maintenance). Effect sizes for measures of quality (k = 4) ranged from -0.01 to 0.31 with an overall mean effect size of g = 0.17 [CI = -0.08, 0.42]. The research quality of transcription studies also varied. Across the 7 studies, an average of 76% of the QIs were met (range = 47% to 100%). Common strengths across group design studies included random assignment of participants to condition (86%); clear descriptions of participants (100%), intervention components (100%), interventionists (86%), and control conditions (86%); and measures with evidence of reliability and validity (86%) that were well-aligned with the interventions (100%). Across all transcription studies, data analyses were appropriately linked to the research questions and to the unit of analysis, and findings converged with previous results. Notable weaknesses of transcription studies included a failure to describe critical features of the setting (only 43% included this information), and failure to include critical information about data collectors (29% to 43% included information about training, whether they were blind to condition or equally familiar with participants across conditions).

Two studies (Graham et al., 2000; Graham et al., 2002) met our criteria for 'exemplary' studies. Both met 100% of the QIs for group designs. Graham et al.'s (2000) handwriting intervention yielded an overall mean effect size of 0.92 [CI = 0.44, 1.41] and Graham et al.'s 2002 spelling intervention yielded a mean effect of g = 0.74 [CI = 0.20, 1.29] on measures of writing quantity. Intervention features included in these two studies are described in detail below.

Intervention features. Graham et al. (2000) implemented a handwriting intervention that involved 27 lessons divided into 9 units. Each unit included three lowercase letters. Frequently-used, easier letters were taught in earlier lessons. Letters in each unit shared common features (e.g., slanting lines: *v, w, y*); easily-confused or reversible letters were taught separately. Each lesson consisted of four activities. In "Alphabet Warm-up," the student identified letters by singing and playing alphabet games. For "Alphabet Practice," the student (a) copied the tutor's model to form each letter, (b) compared and contrasted the forms of the letters, (c) practiced writing the letters using visual cues, and (d) identified the best-written letter. During "Alphabet Rockets," the student copied a sentence containing multiples of the three letters for 3 min, then counted and graphed the number of letters copied. During "Alphabet Fun," the student wrote the target letters in an unusual way (e.g., long and tall, short and fat).

Graham et al. (2002) implemented a spelling intervention consisting of 48 lessons across 8 units. In each unit, students learned two or more spelling patterns involving short and/or long vowel sounds, and conducted five activities. In "Phonics Warm-up," students identified letters corresponding to sounds using picture cards. For "Word Building," they built words that corresponded to the spelling patterns in that unit by placing a card including consonant, blend, or diagraph at the front of a rime card (e.g., *ig*). During "Word Sort," they categorized words by spelling patterns emphasized in that unit and identifying spelling patterns or rules. For "Word Hunt," they hunted for words with the spelling patterns. During "Word Study," they studied words by saying the word and studying the letters, saying the letters with eyes closed, writing the word three times without looking at it, and correcting any misspellings. In each unit, students were tested on whether they mastered the spelling words used in word building and word study activities, and reviewed words from previous units.

Text Generation Intervention

Only one study of text generation as the sole component targeted in intervention

(Pennington, Stenhoff, Gibson, & Ballou, 2012) met criteria for this review. This single subject

design study included one child with autism. His special education teacher implemented 11

intervention sessions for about 10 min per session with 100% fidelity.

Effectiveness and quality. PAND was 83% for a measure of quantity, Phi was 0.64, and

research quality was high (89% of QIs met); thus, the study met our 'exemplary' criteria. The

only identified weaknesses were that the authors did not provide a highly detailed description of

the participant or how he was selected.

Intervention features. The intervention consisted of computer-assisted instruction (CAI)

paired with simultaneous prompting (a strategy shown to be effective for students with autism

spectrum disorders) to teach story construction. The CAI software (*Pixwriter*™*)* consisted of two

windows: the bottom half displayed a word bank and the top half was a word processor. When

the student selected a word from the word bank, the computer software read the word aloud and

the word appeared in the word processor window. After completing a story, the student could

listen to the whole story by clicking a 'speak' button.

During the intervention, the teacher used a simultaneous prompting strategy to teach the

student to construct stories using words associated with places, actions, and events about a main

character. First, the teacher used an *attentional cue* (e.g., "Look" or "Get ready") to draw the

student's attention to the computer screen, and asked the student to write a story. Then, the

teacher used a *controlling prompt* by pointing to a word on the screen for the student to select. If

the student selected the wrong word, the teacher deleted the word and used a *physical prompt* to

draw the mouse to the correct word. The teacher continued these prompts until the student

completed the story. After the student finished writing a story, the teacher praised the student verbally and encouraged him to listen to the story through the text reading function.

Transcription plus Text Generation Interventions

Two studies employed a multi-component approach in which students received explicit instruction in both transcription skills *and* text generation (Berninger et al., 1995; Berninger et al., 2002). Of these, one included students with disabilities (Berninger et al., 1995), and one reported conducting intervention in a school-based setting (Berninger et al., 2002). Neither study reported that a classroom teacher led the intervention. Intervention sessions lasted from 20 to 60 min, for 14-24 sessions. Fidelity, when reported (in Berninger et al., 2002) was high (93%-100%). In both studies, researchers compared explicit transcription instruction (primarily in spelling) with and without instruction in text generation (explicit instruction in generating ideas and translating them into text), to provide support for the theoretical model of early writing development that emphasizes the importance of both transcription and text generation.

Effectiveness and quality. In both studies, interventions that included both components led to stronger effects on children's composing skills; however, effect size information was only available for Berninger et al. (2002). Hedge's *g* for a measure of quantity was 0.19 [CI -0.41, 0.79]. Overall research quality ratings were 16% (Berninger et al., 1995) and 79% (Berninger et al., 2002). The 1995 study contained limited detail regarding many study features included in the QI ratings, leading to its lower rating. The 2002 study overcame many of these limitations, with clear descriptions of participants, intervention and control conditions, measures, and data analysis. Weaknesses included insufficient information regarding attrition, critical features of the intervention setting, and control over possible confounds (e.g., allocation of tutors to groups was not described). Due to these limitations, neither study met our 'exemplary' criteria.

Text Generation plus Self-Regulation Interventions

Fifteen studies that met inclusion criteria for this review included a combination of text generation and self-regulation components as a focus of intervention (there were no studies that examined self-regulation in the absence of some type of text generation). Of the 15 studies, 12 (80%) included students with identified disabilities, all were conducted in school-based settings, and 1 (7%) reported that a classroom teacher led the intervention (the rest were implemented by researchers or graduate students). Intervention sessions lasted from 20-45 min; total durations ranged from 2 weeks to 6 months. Fidelity, reported in all studies, was high (88% to 100%).

Almost all studies of text generation plus self-regulation interventions employed a specific approach called Self-Regulated Strategy Development (SRSD). SRSD involves teaching students to use strategies that help them remember important text generation processes as well as to regulate their use of these writing processes. SRSD incorporates explicit instruction, modeling, mnemonics, and scaffolding for students until they reach mastery and can use the strategies with few or no supports (Baker, Chard, Ketterlin-Geller, Apichatabutra, & Doabler, 2009). SRSD was developed by Harris and Graham (1996), has been evaluated by numerous independent research groups, and has been shown to be effective for students of a wide range of grade levels. In a recent synthesis, Baker et al. (2009) determined that SRSD met the criteria for an 'evidence-based practice' as defined by Gersten et al. (2005).

Effectiveness and quality. Effect sizes for measures of quantity ($k = 36$) ranged from $g = 0.53$ to 1.61 for group design studies (given that there were only three group design studies, we did not calculate an overall mean effect). PAND for measures of writing quantity ranged from 95% to 100%; Phi was 0.90 to 1.0. Effect sizes for measures of writing quality ($k = 20$) ranged

from $g = 0.55$ to 1.18 for group design studies. PAND for measures of writing quality ranged from 94% to 100%; Phi was 0.82 to 1.0.

Overall, the quality of these studies was quite high. Across the three group design studies, an average of 96% of the QIs were met (range = 95% to 100%), and across the 12 single-subject design studies, an average of 92% were met (range = 79% to 100%). There were no systematic weaknesses across studies. The high quality of studies, along with strong effects, suggest that SRSD is a highly promising intervention for addressing text generation and self-regulation needs of struggling writers. Two group studies and 12 single subject studies met our exemplary criteria ($n = 14$); intervention features from these studies are described below.

Intervention features. Each study incorporated six basic stages of SRSD instruction: (1) *Develop Background Knowledge*--the teacher pre-teaches skills needed for using the strategy (e.g., how to revise a story); (2) *Discuss It*--the teacher and students discuss the benefits of the strategy and how and when to use it; (3) *Model It*--the teacher models the strategy using a think-aloud approach; (4) *Memorize It*--students use mnemonics and self-instructions to recall the strategy; (5) *Support It*--the teacher scaffolds students' use of the strategy through collaborative writing and guided practice; and (6) Independent Performance--students apply the strategy independently to various writing tasks, and evaluate their own performance with teacher support. In addition, students learned self-regulation procedures including goal setting, self-monitoring, self-reinforcement, and self-instruction.

All 14 exemplary studies incorporated combinations of strategies for writing stories or opinion essays within the above six stages. Each study included a general planning strategy represented by the mnemonic "POW," which stands for Pick my idea, Organize my notes, and Write and say more. During the "Organize my notes" stage, students learned one or two genre-

specific strategies. For story writing, students learned to use the strategy "WWW, What = 2, How = 2" to describe who, what, when, where, and how things happen in the story. For opinion essays, students learned the mnemonic "TREE" which stands for "Topic Sentence, Reasons – three or more, Ending, and Examine" to organize ideas. Two studies used a combination of POW + TREE (Little et al., 2010; Mason & Shriner, 2008), nine studies used POW + WWW (Asaro-Saddler, 2014; Asaro-Saddler & Saddler, 2010; Lane et al., 2010; Lane et al., 2008; Lienemann, Graman, Leader-Janssen, & Reid, 2006; Reid & Lienemann, 2006; Saddler, 2006; Saddler & Asaro, 2007; Saddler, Moran, Graham, & Harris, 2004), and three studies used both POW + WWW and POW + TREE (Graham, Harris, & Mason, 2005; Harris, Graham, & Mason, 2006; Lane et al., 2011).

Discussion

The purpose of this best-evidence synthesis was to determine the extent to which research-based interventions are available to improve outcomes for young students identified as at-risk or with disabilities that affect their early writing development. Further, we sought to determine the effectiveness of existing interventions and overall quality of the research, and to describe features of interventions from 'exemplary' studies—those studies with strong evidence of effectiveness and the highest research quality ratings. Below, we discuss our overall findings with respect to our research questions, and consider directions for future research and practice.

Availability, Effectiveness, and Quality of Research-Based Early Writing Interventions

Our review of the literature revealed a range of research-based early writing interventions that address one or more of the three components of the theoretical model of early writing development described in the introduction (transcription, text generation, and self-regulation). In the area of transcription, quality of studies varied; however, studies provided promising evidence

that explicit, systematic instruction in handwriting and spelling not only improves student performance on these specific skills, but can also lead to improved outcomes in terms of written composition quantity and quality. These findings are consistent with those of previous syntheses (Datchuk & Kubina, 2012; Graham et al., 2012), and support a model of early writing development that specifies transcription as a critical component of the writing process that should be addressed as part of writing instruction (Berninger, 2009; McCutchen, 2006).

Only one study examined text generation exclusively (Pennington et al., 2012), and was conducted with only one student with autism, which limits conclusions that can be drawn about interventions focusing primarily on text generation. This study suggests that CAI paired with teacher prompting holds promise for supporting students' selection of words for story composition, but requires further investigation. We were somewhat surprised not to find other studies that focused primarily on text generation for young students. For example, many students who experience writing difficulties struggle with basic syntactic and semantic knowledge needed to construct sentences (Graham, Harris, & McKeown, 2013), and would likely benefit from explicit instruction in this area. Further research aimed at developing and evaluating interventions focusing on text generation for young students seems warranted.

A number of studies combined text generation with self-regulation; nearly all of these studies examined effects of SRSD for young writers. These studies were generally of high quality, and provided ample evidence that providing students with both text generation and self-regulation strategies through SRSD leads to improved writing composition. This finding is consistent with results from Graham et al.'s (2012) meta-analysis of elementary-level writing interventions, in which SRSD was identified as a strong intervention. Findings also converge with the overall SRSD research (conducted with a wider range of grade levels) indicating that

SRSD can be considered 'evidence-based' (Baker et al., 2009). For young children, pairing the general planning strategy "POW" with genre-specific strategies (WWW or TREE) appears to be a particularly useful approach for improving children's story and persuasive essay writing.

Limitations

Findings of this synthesis should be interpreted in light of the following limitations. First, although we attempted to be comprehensive and exhaustive in our literature search, it is possible that we overlooked relevant studies. Second, because we set out to complete a best-evidence synthesis, we purposely excluded intervention studies that did not meet our minimum criteria for quality. Thus, additional interventions do exist, but are not included in this review. Third, we required that studies include a measure of writing composition quantity or quality, given our focus on improving students' overall writing proficiency. However, this focus may draw attention away from studies with important findings related to component skills of writing (e.g., handwriting, spelling, planning, pre-writing, idea generation, and so on)—and we acknowledge that studies that did not assess composition may still contribute to knowledge related to early writing intervention. Finally, when calculating effect sizes for group design studies, aggregated effects were computed for each study across measures of quantity and quality; thus, relevant information on the effects of a particular intervention component or the saliency of a particular measure to capture effectiveness may have been masked.

Future Research Directions

Several clear directions emerge from this review. First, relatively little research has been conducted on interventions for students in the primary grades: none were identified in kindergarten, and only three studies were conducted with first-graders (all transcription studies). Further research conducted with primary-grade children could provide valuable options for early

interventions that might prevent later writing difficulties or disabilities. Research is especially needed to identify interventions to improve young writers' text-generation skills. For example, interventions targeting sentence-level writing skills might be particularly important for beginning writers (e.g., instruction focusing on word selection, simple and compound sentence structure, and other aspects of syntax and semantics; Graham et al., 2013). Sentence-level text generation interventions (such as sentence combining interventions, e.g., Saddler & Graham, 2005) have been demonstrated to be effective for slightly older elementary students (see Datchuk & Kubina, 2012); it would be worthwhile to extend these approaches downward to early elementary grades. For self-regulation skills, most of the research conducted thus far at the early elementary grades has used single subject design methods; additional group experimental research would provide further generalizable support for this approach.

Second, more information is needed regarding the specific instructional conditions that are needed to maximize intervention effects. For example, the frequency and duration of interventions varied widely, particularly across transcription studies. An important question to be addressed in future research is: How much intervention is needed? Questions regarding the feasibility and effectiveness of interventions when implemented with groups of varying sizes would also be useful for determining how best to incorporate early writing intervention into schools' instructional programs. In addition, it would be useful to determine the effects of interventions that *combine* transcription instruction with text generation instruction, given the multi-dimensional nature of children's writing development. Two studies (Berninger et al., 1995; Berninger et al., 2002) provide preliminary evidence of the promise of combining approaches; additional, high-quality studies are needed to provide further evidence of the effectiveness of this

approach. The role of technology in improving writing performance is also in need of further research—only one study located for this review used any form of CAI.

Third, a striking feature of most studies included in this synthesis was that researchers or research staff usually implemented the interventions (e.g., in all but one each of the transcription and self-regulation studies). An important question is whether similar effects would be observed when classroom teachers or other school-based personnel implement these interventions. Related to this question is: What types of professional development and supports are needed to ensure that teachers can implement early writing interventions with fidelity, and what levels of fidelity are needed to produce meaningful gains in students' early writing outcomes?

Implications for Practice

Despite the need for continued research, findings of this review have clear utility for practice. In answer to our primary questions, research-based early writing interventions do exist, particularly for transcription and self-regulation, and a number of studies have been conducted with high quality and yielded evidence of effectiveness. Practitioners may be particularly interested in the finding that explicit transcription instruction (handwriting and spelling) leads to improved writing composition. Indeed, such foundational skills-based instruction might be needed for students who struggle with writing, to free up cognitive attention needed to engage in the more complex writing tasks that are currently required in school. These skills are often underemphasized both in state standards and popular curricula (e.g., those that use a Writer's Workshop approach), yet are essential for many students' attainment of writing proficiency.

Instruction that incorporates SRSD also shows great promise to benefit many young children. SRSD may be particularly appealing, as it incorporates explicit instruction focused on critical writing strategies that are of focus in the early grades (e.g., planning, organizing, adding

details), provides a structure for supporting students' independent use of these strategies, and can be applied to multiple genres (e.g., stories and essays).

Conclusions

The multi-component nature of writing demands that teachers have a comprehensive toolkit of instructional strategies to meet the individual needs of children who experience difficulty with writing. Findings of this review indicate that such tools do exist, and that a number of intervention options are supported by high-quality research and strong evidence of effects. These findings are encouraging given the importance of early intervention in preventing long-term negative consequences of writing difficulties. In addition to a toolkit of research-based early writing interventions, it is essential to identify students with writing difficulties accurately, diagnose problems, and monitor progress in order to provide timely and appropriate interventions. Thus, we strongly recommend that interventions such as those highlighted in this review be implemented as part of a coordinated system of early identification, assessment, and intervention, in order to have a meaningful impact on students' writing outcomes.

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Table 1

Study Design and Grade Levels by Area of Writing Focus

	Transcription	Text Generation	Transcription plus Text Generation	Text-Generation plus Self-Regulation	Total
Study Design	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)
Group	7 (100)	0	2 (100)	3 (20)	11 (46)
Single Subject	0	1 (100)	0	12 (80)	13 (54)
Total	7	1	2	15	25
Grade Level (Age)					
1 (6 yrs)	3 (43)	0	0	0	3
2 (7 yrs)	3 (43)	1 (100)	0	11 (73)	15
3 (8 yrs)	1 (14)	0	2 (100)	3 (20)	6
Multiple grades	0	0	0	1 (7)[a]	1

Note. [a]Included students in Grades 2, 3, & 4

Table 2

Summary of Transcription, Text Generation, and Self-Regulation Studies

	Participants		Intervention					Measures & Findings		
Citation	Participant characteristics	Location/ Setting	Focus and Description	Duration/ Frequency	Implement-er	Fidelity	Study Design	Dependent Variables	Effect Size[a]	QI%
				Transcription Studies						
Berninger et al. (1998)	Grade 2 (*n*=128); Students with writing difficulties	Not specified	Spelling; letter-sound, onset-rime, and whole word methods	24 sessions; 20-min/ session; 2 x/week	Graduate students	14.74-14.56 out of 15	Group	**Quantity** Number of words written, spelled correct	NA	79%
Berninger et al. (2000)	Grade 3 (*n*=95); Students below grade level after Grade 2 spelling intervention	Not specified	Spelling; alphabet principle and syllabus awareness at subword, word, and text levels	12 sessions; 20-min/ session; 2 x/week	Not specified	Assessed but not reported	Group	**Quantity** Number of words	0.84 [0.26, 1.42] P	47%
Berninger et al. (2006)	Grade 1 (*n*=14); Students with difficulty forming letters	Not specified	Handwriting; neurodevelopmental activities, visual and verbal modeling	10 sessions; 30-min/ session	Doctoral students	Not reported	Group	**Quality** Writing quality (WJ-R)	0.31 [-0.06, 0.68] P	53%
Berninger et al. (1997)	Grades 3-6 (*n*=6); Students with SLD (*n*=4), ADD (*n*=1), autism (*n*=1)	Summer writing camp	Handwriting; motor imitation, visual cues, memory retrieval, copying	12 weeks; 20-min/ session; 2 x/week	Graduate students	Not reported	Group	**Quantity** Writing fluency (WJ-R)	0.38 [0.13, 0.64] P	74%
Graham et al. (2000)	Grade 1 (*n*=38); Students at-risk (*n* = 24) or with SLI, LD, ADHD, or DD (*n*=14)	Suburban; in and outside classroom	Handwriting; modeling, practice, and fluency-building activities	9 weeks; 27 sessions; 15-min/ session	Graduate students	99.40%	Group	**Quantity** Writing fluency (WJ-R) **Quality** Holistic rating	0.92 [0.44, 1.41] P -0.01 [-0.65, 0.63] P	100%
Graham et al. (2002)	Grade 2 (*n*=54); Students with SLI (*n*=12), SLD (*n*=5), ADHD (*n*=3), EBD (*n*=2), DD (*n*=1)	Urban; outside classroom	Spelling; phonemic awareness, word building, word sorting, word hunting, and word Study	6 months, 48 sessions; 20-min/ session; 2x/week	Graduate students	98%-99.10%	Group	**Quantity** Writing fluency (WJ-R, story length) **Quality** Holistic rating	0.20 [-0.18, 0.58] P; 0.32 [-0.06, 0.70] M 0.06 [-0.47, 0.59] P; 0.24 [-0.28, 0.77] M	100%
Jones & Christensen (1999)	Grade 1 (*n*=38); Students with handwriting difficulties	Not specified; classroom	Handwriting; modeling, practice, and fluency-building activities	8 weeks; 10-min/ session	Classroom teacher	Not reported	Group	**Quality** Holistic rating	-0.09 [-0.72, 0.53] P	68%

Text Generation Study										
Pennington et al. (2012)	7-year-old male with ASD and writing difficulties	Not specified; special ed classroom	Story construction; Computer-assisted instruction with simultaneous prompting	Less than 2 hours total; 10 min/ session	Classroom teacher	100%	Single Subject	**Quantity** Number of sentences	83%/0.64 [0.44, 0.79] P	89%
Transcription plus Text Generation Studies										
Berninger et al. (1995)	Summer after Grade 3 (*n*=24); Students with writing difficulties	Not specified	Spelling instruction with and w/o explicit instruction in text generation	14 sessions; 1-hr/ session	Experienced clinician	Not reported	Group	**Quantity** Number of words **Quality** Holistic rating	NA	26%
Berninger et al. (2002)	Grade 3 (*n*=96); Students with low compositional fluency	Elementary school	Spelling instruction with and w/o explicit instruction in text generation	24 sessions; 20-min each	Graduate students	93-100%	Group	**Quantity** Number of words	0.19 [-0.41, 0.79] P	79%
Text Generation plus Self-Regulation Studies										
Asaro-Saddler & Saddler (2010)	Grade 2 (*n*=2); Students with ASD and writing difficulties	Urban; special education classroom	SRSD: POW + WWW	6 sessions; 30-min/ session	Graduate students	100%	Single Subject	**Quantity** Number of story elements; # of words	96%/0.92 [0.92, 0.77] P; 100%/1.0 [0.83, 1.0] M	95%
								Quality Holistic rating	96%/0.92 [0.92, 0.77] P; 100%/1.0 [0.89,1.00] M	
Asaro-Saddler (2014)	Grade 3 (*n*=3); Students with ASD and writing difficulties	Urban; resource room	SRSD: POW + WWW	7-8 sessions; 45-min, 3 x/week	Classroom teachers master's in special ed	95%	Single Subject	**Quantity** Number of story elements; # of words	95%/0.90 [0.75, 0.97] P	100%
								Quality Holistic rating	100%/1.0 [0.89, 1.0] P	
Dunn (2013)	Grade 2 (*n*=2); Students with SLD and IEP writing goals	Suburban school	Used art media during pre-writing with Ask, Reflect, Text (ART) strategy	25 sessions; 45-min/ session	A recent university graduate	99%	Single Subject	**Quantity** Number of story elements	100%/1.0 [0.89, 1.0] P	79%
								Quality Holistic rating	94%/0.82 [0.65, 0.92] P	
Graham et al. (2005)	Grade 3 (*n*= 73); Students with SLD (*n*=12), SLI (*n*=4), ADHD (*n*=2), EBD (*n*=2)	Urban; outside classroom	SRSD: POW + WWW & POW + TREE	5 months; 20-min/ session; 3 x/week	6 graduate students in education	95%-97%	Group	**Quantity** Number of words; # of text elements	1.30 [1.07, 1.54] P; 1.05 [0.63, 1.46] M	100%
								Quality Holistic rating	1.08 [0.78, 1.39] P; 1.18 [0.58, 1.77] M	

Study	Participants	Setting	Intervention	Duration	Interventionist	Fidelity	Design	Measure	Results	IOA
Harris et al. (2006)	Grade 2 (*n* = 66); Students with SLD (*n*=3), SLI (*n*=7), and EBD (*n*=2)	Urban; outside classroom	SRSD: POW + WWW & POW + TREE	6 months; 20-min/ session; 3 x/week	6 graduate students	91%- 93%	Group	**Quantity** Number of words; # of text elements	1.61 [1.42, 1.80] P; 1.57 [1.22, 1.91] M	95%
								Quality Holistic rating	0.90 [0.67, 1.12] P; 1.04 [0.59, 1.49] M	
Lane et al. (2008)	Grade 2 (*n*=6); Students with behavioral and writing difficulties	Rural; outside classroom	SRSD: POW + WWW	10 to 15 sessions; 30-min/ session; 3-4 x/week	3 graduate students in special or general education	94%- 100%	Single Subject	**Quantity** Number of story elements	100%/1.0 [0.89, 1.0] P; 100%/1.0 [0.89, 1.0] M	95%
Lane et al. (2010)	Grade 2 (*n*=13); Students with EBD and writing difficulties	Rural; outside classroom	SRSD: POW + WWW	7-15 lessons; 30-min/ session; 3-4 x/week	8 graduate students in education	90.83% -100%	Single Subject	**Quantity** Number of story elements	97%/0.94 [0.79, 0.99] P; 98%/0.95 [0.78, 1.00] M	95%
Lane et al. (2011)	Grade 2 (*n*=44); Students with behavioral and writing difficulties	Rural; outside classroom	SRSD: POW + WWW & POW + TREE	3-4.5 weeks; 30-min/ session; 3-4 x/week	11 graduate students in education	88%- 88.67%	Group	**Quantity** Number of words; # of text elements	0.53 [0.32, 0.74] P	95%
								Quantity Holistic rating	0.55 [0.25, 0.85] P	
Lienemann et al. (2006)	Grade 2 (*n*=6); Students with ADHD (*n*=1), SLD (*n*=1); and OI (*n*=1)	Rural; outside classroom	SRSD: POW + WWW	6-8 sessions; 30-45 min/ session	First and third authors	100%	Single Subject	**Quantity** Number of words; number of story elements	100%/1.0 [0.89, 1.00] P; 94%/0.89 [0.72, 0.97] M	95%
Little et al. (2010)	Grade 2 (*n*=13); Students with EBD and writing difficulties	Rural; outside classroom	SRSD: POW + TREE	7-15 lessons; 30-min, 3-4 x/week	8 graduate students in education	96.1%- 98.90%	Single Subject	**Quantity** Number of essay elements	100%/1.0 [0.89, 1.0] P; 100%/1.0 [0.89, 1.0] M	89%
Mason & Shriner (2008)	Grade 2 (*n*=2), Grade 3 (*n*=2); Students with or at-risk for EBD and writing difficulties	Not specified; resource room	SRSD: POW + TREE	11 to 13 sessions; 30-min/ session	Doctoral students	98%- 100%	Single Subject	**Quantity** Number of essay elements	97%/0.94 [0.79, 0.99] P; 100%/1.0 [0.85, 1.00] M	95%
Reid & Lienemann (2006)	Grade 3 (*n* = 1), Grade 4 (*n* =2); Students with ADHD and writing difficulties	Midwestern; outside classroom	POW + WWW	30-min individual session (7-8 lessons)	Doctoral student	99%	Single Subject	**Quantity** Number of words; # of story elements	100%/1.0 [0.89, 1.0] P; 100%/1.0 [0.88, 1.0] M	89%

Saddler & Asaro (2007)	Grade 2 (*n* = 6); Students with IEP and writing difficulties	Urban; outside classroom	SRSD: POW + WWW	11 to 12 lessons; 30-min, 3x per week	Not specified	97%	Single Subject	**Quantity** Number of story elements	100%/1.0 [0.89, 1.0] P	95%
								Quality Holistic rating; quality changes	98%/0.93 [0.79, 0.98] P	
Saddler (2006)	Grade 2 (*n*=6); Students with SLD and writing difficulties	Urban; outside classroom	SRSD: POW + WWW	11 to 12 lessons; 30 min per session; 3 x per week	A graduate student in educational psychology	96%	Single Subject	**Quantity** Number of words; # of story elements	100%/1.0 [0.89, 1.0] P; 96%/0.92 [0.77, 0.92] M	95%
								Quality Holistic rating	100%/1.0 [0.89, 1.0] P; 96%/0.92 [0.77, 0.92] M	
Saddler et al. (2004)	Grade 2 (*n*=6); Students with writing difficulties	Suburban; outside classroom	SRSD: POW + WWW	25-min/ session; 3 x per week	First author	97%-99%	Single Subject	**Quantity** Number of story elements	100%/1.0 [0.89, 1.0] P; 94%/0.84 [0.63, 0.94] M	89%

Note: ADD=Attention-Deficit Disorder; ADHD=Attention Deficit Hyperactivity Disorder; ASD=Autism Spectrum Disorder; DD=Developmental Delay; EBD=Emotional/Behavioral Disorder; IEP=Individualized Education Program; OI=Orthopedic Impairment; SLI=Speech/Language Impairment; SLD=Specific Learning Disabilities; SRSD=Self-Regulated Strategy Development; WRAT-3=*Wide Range Achievement Test-3rd Edition* (Wilkinson, 1993); WIAT=*Wechsler Individual Achievement Test* (The Psychological Corporation, 1992); WRMT-R=*Woodcock Reading Mastery Test-Revised* (Woodcock, 1987); WISC-3=*Wechsler Intelligence Scale for Children-3rd Edition* (Wechsler, 1991); WJ-R=*Woodcock Johnson Psycho-educational Battery-Revised* (Woodcock & Johnson, 1990); TWS-3=*Test of Written Spelling-3* (Larsen & Hammill, 1994).

[a] Hedge's *g* computed for composing measures in group design studies; PAND and Phi reported for composing measures of single subject design studies; effect sizes include posttest (P) and maintenance (M) when available.

Table 2 *(cont.)*

Citation	Participants		Intervention					Measures and Findings		
	Participant characteristics	Location/ Setting	Description	Duration/ Frequency	Implement -er	Fidelity	Study Design	Dependent Variables	Effect Size[a]	QI%
			Text Generation Study							
Pennington et al. (2012)	7-year-old male with ASD and writing difficulties	Not specified; special ed classroom	Story construction; Computer-assisted instruction with simultaneous prompting	Less than 2 hours total; 10 min/ session	Classroom teacher	100%	Single Subject	**Quantity** Number of sentences	83%/0.64 [0.44, 0.79] P	89%
			Transcription plus Text Generation Studies							
Berninger et al. (1995)	Summer after Grade 3 (*n* =24); Students with writing difficulties	Not specified	Spelling instruction with and without explicit instruction in generating ideas and translating into text	14 sessions; 1-hr per session	Experience d clinician	Not reported	Group	**Quantity** Number of words **Quality** Holistic rating	NA	26%
Berninger, et al. (2002)	Grade 3 (*n* =96;); Students with low compositional fluency	Elementary school	Spelling instruction with and without explicit instruction in generating ideas and translating into text	24 sessions; 20-min each	Graduate Students	93-100%	Group	**Quantity** Number of words	0.19 [-0.41, 0.79] P	79%
			Text Generation plus Self-Regulation Studies							
Asaro-Saddler & Saddler (2010)	Grade 2 (*n* =2); Students with ASD and writing difficulties	Urban; special education classroom	Self-regulated Strategy Development (SRSD): POW + WWW	6 sessions; 30-min/ session	Graduate Students	100%	Single Subject	**Quantity** Number of story elements; number of words **Quality** Holistic rating	96%/0.92 [0.92, 0.77] P; 100%/1.0 [0.83, 1.0] M 96%/0.92 [0.92, 0.77] P; 100%/1.0 [0.89,1.00] M	95%
Asaro-Saddler (2014)	Grade 3 (*n* =3); Students with ASD and writing difficulties	Urban; resource room	SRSD: POW + WWW	7-8 sessions; 45-min/ session; 3 x/week	Classroom teachers with master's in special ed	95%	Single Subject	**Quantity** Number of story elements; number of words **Quality** Holistic rating	95%/0.90 [0.75, 0.97] P 100%/1.0 [0.89, 1.0] P	100%
Dunn (2013)	Grade 2 (*n* =2); Students with SLD and IEPs with writing goals	Suburban school	Used art media during pre-writing with Ask, Reflect, Text (ART) strategy	25 sessions; 45-min/ session	A recent university graduate	99%	Single Subject	**Quantity** Number of story elements **Quality** Holistic rating	100%/1.0 [0.89, 1.0] P 94%/0.82 [0.65, 0.92] P	79%

Table 2 *(cont.)*

	Participants		Intervention					Measures and Findings		
Citation	Participant characteristics	Location/ Setting	Focus and Description	Duration/ Frequency	Implement -er	Fidelity	Study Design	Dependent Variables	Effect Size[a]	QI%
			Text Generation plus Self-regulation Studies (*continued*)							
Graham et al. (2005)	Grade 3 (*n* = 73); Students with SLD (*n* =12), SLI (*n* =4), ADHD (*n* =2), EBD (*n* =2)	Urban; outside classroom	SRSD: POW + WWW and POW + TREE	5 months; 20-min/ session; 3 x/week	6 graduate students in education	95%-97%	Group	**Quantity** Number of words; number of text elements	1.30 [1.07, 1.54] P; 1.05 [0.63, 1.46] M	100%
								Quality Holistic rating	1.08 [0.78, 1.39] P; 1.18 [0.58, 1.77] M	
Harris et al. (2006)	Grade 2 (*n* = 66); Students with SLD (*n* =3), SLI (*n* =7), and EBD (*n* =2)	Urban; outside classroom	SRSD: POW + WWW and POW + TREE	6 months; 20-min/ session; 3 x/week	6 graduate students	91%-93%	Group	**Quantity** Number of words; number of text elements	1.61 [1.42, 1.80] P; 1.57 [1.22, 1.91] M	95%
								Quality Holistic rating	0.90 [0.67, 1.12] P; 1.04 [0.59, 1.49] M	
Lane et al. (2008)	Grade 2 (*n* =6); Students with behavioral and writing difficulties	Rural; outside classroom	SRSD: POW + WWW	10-15 sessions; 30-min/ session; 3-4 x/week	3 graduate students in special or general education	94%-100%	Single Subject	**Quantity** Number of story elements	100%/1.0 [0.89, 1.0] P; 100%/1.0 [0.89, 1.0] M	95%
Lane et al. (2010)	Grade 2 (*n* =13); Students with EBD and writing difficulties	Rural; outside classroom	SRSD: POW + WWW	7-15 lessons; 30-min/ session; 3-4 / k	8 graduate students in education	90.83%-100%	Single Subject	**Quantity** Number of story elements	97%/0.94 [0.79, 0.99] P; 98%/0.95 [0.78, 1.00] M	95%
Lane et al. (2011)	Grade 2 (*n* =44); Students with behavioral and writing difficulties	Rural; outside classroom	SRSD: POW + WWW and POW + TREE	3-4.5 weeks; 30-min/ session; 3-4 x/week	11 graduate students in education	88%-88.67%	Group	**Quantity** Number of words; number of text elements	0.53 [0.32, 0.74] P	95%
								Quantity Holistic rating	0.55 [0.25, 0.85] P	
Lienemann et al. (2006)	Grade 2 (*n* =6); Students with ADHD (*n* =1), SLD (*n* =1); and OI (*n* =1)	Rural; outside classroom	SRSD: POW + WWW	6-8 sessions; 30-45 min/ session	First and third authors	100%	Single Subject	**Quantity** Number of words; number of story	100%/1.0 [0.89, 1.00] P; 94%/0.89 [0.72, 0.97] M	95%

Table 2 *(cont.)*

	Participants		Intervention					Measures and Findings		
Citation	Participant characteristics	Location/ Setting	Focus and Description	Duration/ Frequency	Implement-er	Fidelity	Study Design	Dependent Variables	Effect Size[a]	QI%
			Text Generation plus Self-regulation Studies (*continued*)							
Little et al. (2010)	Grade 2 (*n*=13); Students with EBD and writing difficulties	Rural; outside classroom	SRSD: POW + TREE	7-15 lessons; 30-min/session;	8 graduate students in education	96.1%-98.9%	Single Subject	**Quantity** Number of essay elements	100%/1.0 [0.89, 1.0] P; 100%/1.0 [0.89, 1.0] M	89%
Mason & Shriner (2008)	Grade 2 (*n*=2), Grade 3 (*n*=2); Students with or at-risk for EBD and writing difficulties	Not specified; resource room	SRSD: POW + TREE	11-13 sessions; 30-min /session	Doctoral students	98%-100%;	Single Subject	**Quantity** Number of essay elements	97%/0.94 [0.79, 0.99] P; 100%/1.0 [0.85, 1.00] M	95%
Reid & Lienemann (2006)	Grade 3 (*n* = 1), Grade 4 (*n* =2); Students with ADHD and writing difficulties	Midwestern; outside classroom	POW + WWW	30-min individual session (7-8 lessons)	Doctoral student	99%	Single Subject	**Quantity** Number of words; number of story	100%/1.0 [0.89, 1.0] P; 100%/1.0 [0.88, 1.0] M	89%
Saddler & Asaro (2007)	Grade 2 (*n* = 6); Students with IEP and writing difficulties	Urban; outside classroom	SRSD: POW + WWW	11-12 lessons; 30-min/ session; 3 x per week	Not Specified	97%	Single Subject	**Quantity** Number of story elements **Quality** Holistic rating; quality changes	100%/1.0 [0.89, 1.0] P 98%/0.93 [0.79, 0.98] P	95%
Saddler (2006)	Grade 2 (*n*=6); Students with SLD with writing difficulties	Urban; outside classroom	SRSD: POW + WWW	11-12 lessons; 30 min per session; 3 x per week	A graduate student in educational psychology	96%	Single Subject	**Quantity** Number of words; number of story **Quality** Holistic rating	100%/1.0 [0.89, 1.0] P; 96%/0.92 [0.77, 0.92] M 100%/1.0 [0.89, 1.0] P; 96%/0.92 [0.77, 0.92] M	95%
Saddler et al. (2004)	Grade 2 (*n*=6); Students with writing difficulties	Suburban; outside classroom	SRSD: POW + WWW	25-min/ session; 3 x per week	First author	97%-99%	Single Subject	**Quantity** Number of story elements	100%/1.0 [0.89, 1.0] P; 94%/0.84 [0.63, 0.94] M	89%

Note: ADD=Attention-Deficit Disorder; ADHD=Attention Deficit Hyperactivity Disorder; ASD=Autism Spectrum Disorder; DD=Developmental Delay; EBD=Emotional/Behavioral Disorder; IEP=Individualized Education Program; OI=Orthopedic Impairment; SLI=Speech/Language Impairment; SLD=Specific Learning Disabilities; WRAT-3=*Wide Range Achievement Test-3rd Edition* (Wilkinson, 1993); WIAT=*Wechsler Individual Achievement Test* (The Psychological Corporation, 1992); WRMT-R=*Woodcock Reading Mastery Test-Revised* (Woodcock, 1987); WISC-3=*Wechsler Intelligence Scale for Children-3rd Edition* (Wechsler, 1991); WJ-R=*Woodcock Johnson Psycho-educational Battery-Revised* (Woodcock & Johnson, 1990); TWS-3=*Test of Written Spelling-3* (Larsen & Hammill, 1994).

[a] Hedge's *g* computed for composing measures in group design studies; PAND and Phi reported for composing measures of single subject design studies; effect sizes include posttest (P) and maintenance (M) when available.

Table 3

Quality Indicators Applied to Group Design Studies

Area of Writing	Study	Participants/Setting					Intervention/Comparison					
		Comparable across conditions	Random assign	Attrition described	Characteris-tics clearly described	Critical features of setting	Components clearly described	Where conducted, length	Interventionist clearly described	Possible confounds	Fidelity described	Nature of control condition described
TR	Berninger et al. (2006)	1	1	0	1	0	1	0	1	1	0	1
TR	Berninger et al. (1997)	0	1	1	1	0	1	1	1	1	1	1
TR	Berninger et al. (1998)	1	1	1	1	0	1	1	1	1	1	1
TR	Berninger et al. (2000)	1	1	0	1	0	1	0	0	0	0	0
TR	Graham et al. (2000)	1	1	1	1	1	1	1	1	1	1	1
TR	Graham et al (2002)	1	1	1	1	1	1	1	1	1	1	1
TR	Jones & Christensen (1999)	1	0	1	1	1	1	1	1	0	0	1
TR+TG	Berninger et al. (1995)	0	1	0	0	0	1	0	0	0	0	0
TR+TG	Berninger et al. (2002)	1	1	0	1	0	1	1	1	0	1	1
TG+SRSD	Graham et al (2005)	1	1	1	1	1	1	1	1	1	1	1
TG+SRSD	Harrison et al (2006)	1	1	0	1	1	1	1	1	1	1	1
TG+SRSD	Lane et al. (2011)	1	1	1	1	1	1	1	1	1	1	1
Total % Met		83	92	58	92	50	100	75	83	67	67	83

Table 3 *(Cont.)*

Area of Writing	Study	Measures					Data Analysis			% of QIs met
		Evidence of Reliability & Validity	Data collectors trained	Data collectors blind to conditions	Data collectors equally familiar to trt/control	Measures aligned with intervention	Linked to research questions	Appropriately linked to unit of analysis	Converge with previous results	
TR	Berninger et al. (2006)	0	0	0	1	1	1	1	1	63
TR	Berninger et al. (1997)	1	0	0	0	1	1	1	1	74
TR	Berninger et al. (1998)	1	0	0	0	1	1	1	1	79
TR	Berninger et al. (2000)	1	0	0	0	1	1	1	1	47
TR	Graham et al. (2000)	1	1	1	1	1	1	1	1	100
TR	Graham et al. (2002)	1	1	1	1	1	1	1	1	100
TR	Jones & Christensen (1999)	1	0	0	0	1	1	1	1	68
TR+TG	Berninger et al. (1995)	0	0	0	0	1	0	0	0	16
TR+TG	Berninger et al. (2002)	1	1	0	1	1	1	1	1	79
TG+SRSD	Graham et al. (2005)	1	1	1	1	1	1	1	1	100
TG+SRSD	Harris et al. (2006)	1	1	1	1	1	1	1	1	95
TG+SRSD	Lane et al. (2011)	0	1	1	1	1	1	1	1	95
Total % Met		75	50	42	58	100	92	92	92	

Note. TR = Transcription; TG = Text Generation; SRSD = Self-Regulated Strategy Development.

Table 4

Quality Indicators Applied to Single Subject Design Studies

Area of Writing	Study	Participants/Setting				Dependent Variable					
		Subjects selected have characteristics of interest	Characteristics clearly described	Process for selection clearly described	Critical features of setting described	Quantifiable, operationalized	Is valid	Measured repeatedly over time	IOA is established	Described with operational/replicable precision	DV, and change in DV, are socially important, practical, cost effective
TG	Pennington et al. (2012)	1	0	0	1	1	1	1	1	1	1
TG+SRSD	Asaro-Saddler (2014)	1	1	1	1	1	1	1	1	1	1
TG+SRSD	Asaro-Saddler & Saddler (2010)	1	1	1	1	1	1	1	1	1	1
TG+SRSD	Dunn (2013)	1	1	1	0	1	0	1	1	1	1
TG+SRSD	Lane et al. (2010)	1	1	1	1	1	1	1	1	1	1
TG+SRSD	Lane et al. (2008)	1	1	1	1	1	1	1	1	1	1
TG+SRSD	Lienemann et al. (2006)	1	1	1	1	1	1	1	1	1	1
TG+SRSD	Little et al (2010)	1	1	1	1	1	1	1	1	1	1
TG+SRSD	Mason & Shriner (2008)	1	1	1	1	1	1	1	1	1	1
TG+SRSD	Reid & Lienemann (2006)	1	1	1	1	1	0	1	1	1	1
TG+SRSD	Saddler (2006)	1	1	1	1	1	1	1	1	1	1
TG+SRSD	Saddler & Asaro (2007)	1	1	1	1	1	1	1	1	1	1
TG+SRSD	Saddler et al. (2004)	1	1	1	1	1	0	1	1	1	1
Total % Met		100	92	92	92	100	77	100	100	100	100

Table 4 *(Cont.)*

Area of Writing	Study	Independent Variable				Baseline		Design			% of QIs met
		Systematically manipulated	Fidelity is overtly measured/reported	Described with operational/replicable precision	Implemented over time, by typical interventionists in typical contexts	Provides pattern of responding	Described with replicable precision	At least 3 demonstrations of effect across at least 3 time points	Permits elimination of competing hypotheses	Effect is replicated across participants, settings, or materials	
TG	Pennington et al. (2012)	1	1	1	1	1	1	1	1	1	89
TG+SRSD	Asaro-Saddler (2014)	1	1	1	1	1	1	1	1	1	100
TG+SRSD	Asaro-Saddler & Saddler (2010)	1	1	1	0	1	1	1	1	1	95
TG+SRSD	Dunn (2013)	1	1	1	0	1	0	1	1	1	79
TG+SRSD	Lane et al. (2010)	1	1	1	0	1	1	1	1	1	95
TG+SRSD	Lane et al. (2008)	1	1	1	0	1	1	1	1	1	95
TG+SRSD	Lienemann et al. (2006)	1	1	1	0	1	1	1	1	1	95
TG+SRSD	Little et al (2010)	1	1	1	0	1	0	1	1	1	89
TG+SRSD	Mason & Shriner (2008)	1	1	1	0	1	1	1	1	1	95
TG+SRSD	Reid & Lienemann (2006)	1	1	1	0	1	1	1	1	1	89
TG+SRSD	Saddler (2006)	1	1	1	0	1	1	1	1	1	95
TG+SRSD	Saddler & Asaro (2007)	1	1	1	0	1	1	1	1	1	95
TG+SRSD	Saddler et al. (2004)	1	1	1	0	1	1	1	1	1	89
Total % Met		100	100	100	15	100	85	100	100	100	

Note. TG = Text Generation; SRSD = Self-Regulated Strategy Development.