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Using Data-Based Instruction to Support Struggling Elementary Writers

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Abstract

Writing is a critical academic and life skill, but many school-age children struggle with the complexity of written expression. Given the importance of writing, there is a clear need for a systematic approach to identifying and supporting struggling writers, including writers with learning and emotional disabilities. One such approach is known as data-based instruction (DBI). This article presents an overview of DBI and guidance on how educators can use the DBI steps with assessment data to inform their classroom writing instruction. Additional resources are shared to support teachers in using DBI with their struggling writers and writers with learning and emotional disabilities.

Keywords

data, data-based instruction, writing, struggling writers

Writing is a critical academic and life skill. The development of written language skills begins before a student enters kindergarten and includes skills like writing letters and one's own name (National Early Literacy Panel, 2008). Once in school, students must write proficiently across content areas and for multiple purposes (e.g., to describe, explain, or persuade) and audiences to meet Common Core State Standards (Graham & Harris, 2013; National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). Students who struggle with writing in school—particularly students with learning and emotional disabilities—are likely to face

academic difficulties along with limited postsecondary education and a 504 plan; NCES, n.d.). At the elementary level, as of 2002, approximately 70% of fourth graders were not proficient in writing, compared with approximately 94% of fourth-grade students with disabilities, including those with a 504 plan (NCES, n.d.). The NCES planned to release a special report on the 2017 National Assessment of Educational Progress writing assessment in the summer of 2020, but as of the writing of this article (July/August 2020) that report was not yet available. Given the large number of students nationally who are not proficient in writing, there is a clear need for a systematic approach to identifying and supporting struggling writers and writers with learning and employment opportunities (Graham & Perin, 2007) as writing is expected in nearly two thirds of salaried jobs. Furthermore, employees who are poor writers are less likely to be hired or promoted (National Commission on Writing for America's Families, Schools, and Colleges, 2004).

Despite the high literacy demands of our society, national assessment data from 2011 indicate that nearly three quarters of eighth and 12th graders are not proficient in writing (National Center for Education Statistics [NCES], n.d.). This number increases to 97% for eighth graders and 95% for 12th graders with disabilities (i.e., excluding those with emotional disabilities). One such approach is data-based instruction (DBI).

Data-Based Instruction

Data-based instruction, originally termed “data-based program modification” (Deno & Mirkin, 1977), is a hypothesis-driven empirical approach to individualizing instruction. Along with curriculum-based measurement (CBM), DBI addresses five critical assumptions. First, to provide effective individualized instruction, educators implement instructional approaches that are research- or evidence-based. Second, effective, research-based instructional approaches exist, but it is impossible to predict whether these approaches will meet the unique needs of each individual student. Third, it can only be hypothesized that a given instructional approach will work for an individual student; thus, one must test whether it is effective for that student. Fourth, to test whether the instructional approach is effective, ongoing assessment data can be collected and used as evidence to determine whether an instructional approach is

working for an individual student. Fifth, the ongoing assessment data used for instructional decision-making should reflect critical academic skills that are expected to improve over time.

Research syntheses (Jung et al., 2018; Stecker et al., 2005) have documented DBI's strong research base in writing, reading, and mathematics. Jung et al. (2018) specifically revealed that positive student outcomes are possible in spelling and writing for students with the most intensive writing needs, including students with learning and emotional disabilities. Recently, DBI has been studied in early writing as part of a large federal project with promising results. Teachers significantly improved their knowledge and skills in DBI, and writing outcomes also improved for students with disabilities (Lembke et al., 2018; McMaster et al., 2020; Poch et al., 2020, 2021). Yet, DBI is not frequently used in practice (D. Fuchs et al., 2010, 2013), suggesting that educators may require supports to effectively individualize instruction using these techniques.

Making Data-Based Decisions

Data-based instruction consists of eight steps (Deno & Mirkin, 1977; McMaster & Lembke, 2014) whereby teachers implement an intervention while regularly monitoring a student's progress and making instructional decisions based on the student's performance. Figure 1 shows the DBI steps. Each DBI step is described along-side a vignette indicating how teachers might implement DBI using various tools for their students, with a focus on writing.

Step 1: Establish Present Level of Performance

To establish baseline or benchmark writing performance, teachers need a progress monitoring measure in writing, such as CBM, with adequate technical features (e.g., reliability and validity) or characteristics of the measure that make it a strong tool so that teachers can have confidence when using it that it gives accurate results (McMaster & Espin, 2007). Curriculum-based measurement serves as global measures of students' academic skills, including writing. As such, the corresponding scoring metrics (see Table 1) capture several subskills that contribute to overall writing performance, meaning that measures do not always directly align with specific skills

taught. Instead, the individual skills taught should contribute to overall writing performance; that is, as a student's writing quantity and quality increase (i.e., presumably aligned with the skills taught during intervention), the student's scores on the scoring measure should also increase.

The most common CBM writing task is a story prompt that provides a student with a story starter and asks the student to write a story using the prompt. Other types of writing tasks have received more limited attention in the literature, including word dictation (i.e., spelling) measures, copying measures, and picture word tasks (i.e., picture paired with words matching the picture, like "cat" or "jump"), to generate sentence writing. Measures with evidence of reliability (i.e., consistency of results) and validity (i.e., measures what it claims to measure) are preferred to teacher-made CBM probes because they provide greater confidence in student performance (Allen et al., 2020). Several types of writing CBMs are available, some for purchase, and are detailed in Table 1. Teachers start by selecting a CBM task that aligns with a student's targeted struggles. Once teachers have identified the specific area(s) in which a student is struggling, and matched that area to a specific CBM measure, they should administer three different forms of the measure to establish a student's baseline level of performance, using the median value as the starting point for setting a long-term goal. Based on the targeted skill(s) and the selected measure, an appropriately aligned scoring metric should also be selected for tracking student performance. The most common scoring metrics are defined in Table 1. These CBM tasks and their corresponding scoring metrics have extensive evidence of reliability and validity (Allen et al., 2020; Hampton & Lembke, 2016; McMaster & Campbell, 2008; McMaster & Espin, 2007; McMaster et al., 2009, 2011; Parker et al., 1991; Videen et al., 1982).

Mrs. Baldwin is a third-grade special educator. She knew her student Kelly (who has an identified learning disability in writing and reads and writes at a second-grade level) was struggling with sentence writing on in-class assignments, so she administered three researcher-developed baseline picture word probes (baseline scores = 3, 10, 12 correct word sequences [CWS]) and plotted Kelly's median value on her progress monitoring graph. Kelly's performance continued to indicate needs related to sentence writing, so

Mrs. Baldwin decided to administer additional picture word probes to test Kelly's performance each week following instruction until the end of the school year (See Note 1).

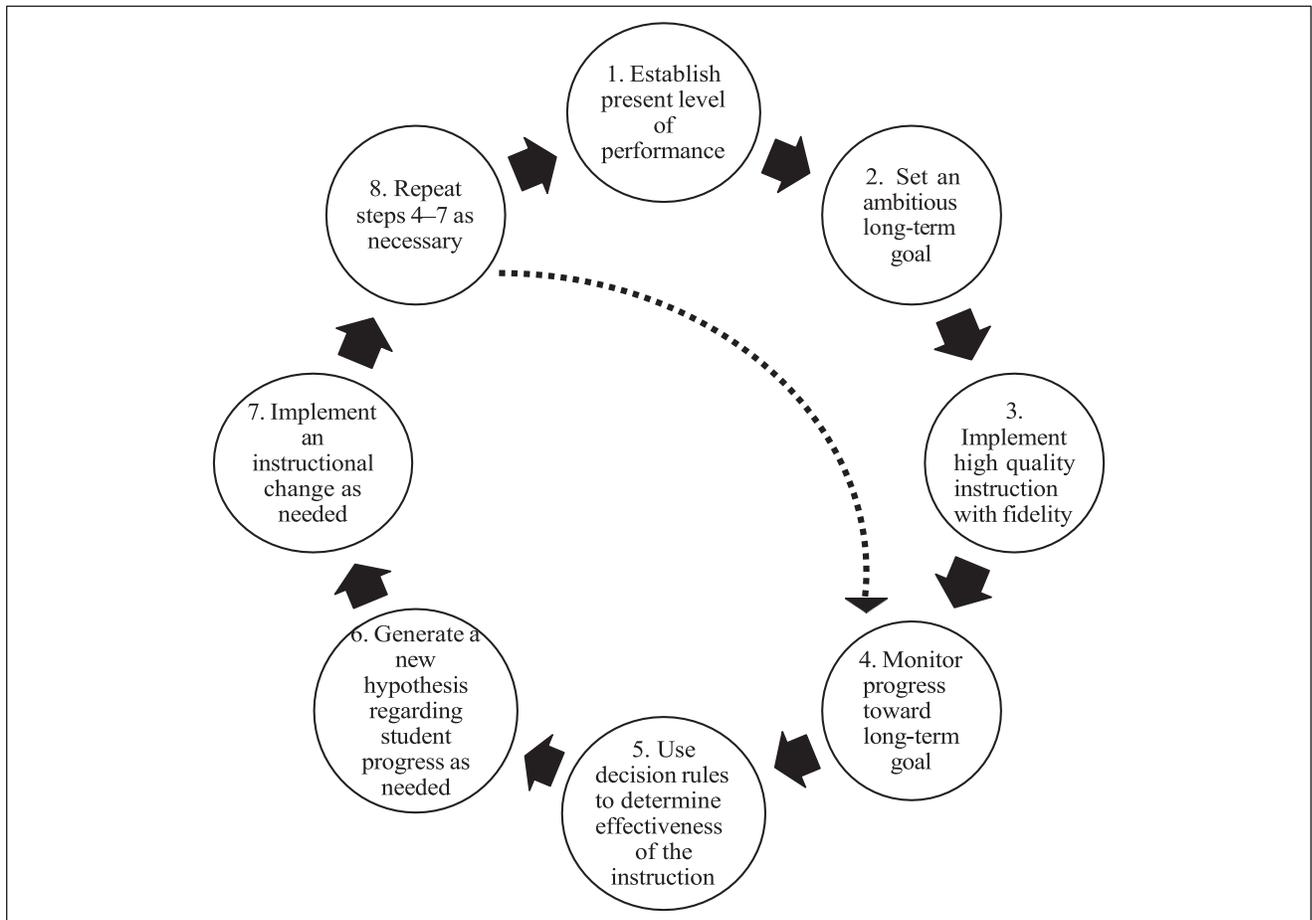


Figure 1. DBI steps.

Note. DBI = data-based instruction.

Step 2: Set an Ambitious Long-Term Goal

Considering a student's individual needs, grade, or age, as well as the amount of time remaining in the school year in which to progress monitor, teachers set a long-term goal. This long-term goal is set at an adequate level of intensity, one that is not too difficult but provides an appropriate level of challenge for the student. When using measures that report normative data, those data should be utilized to determine a student's present level and an appropriate rate of increase. Allen et al. (2020) presented means and standard deviations for picture word and story prompt probes. It is

Table 1. Types of Writing CBMs, When to Use Them, and Common Scoring Metrics.

CBM Probe	Description and Detail	Use When Students Is Developing or Refining...
Word diction	Assesses spelling 2- to 3-min administration Individual administration Common scoring metrics: words written, words spelled correctly, correct letter sequences, correct minus incorrect letter sequences	Word-level skills Spelling Phonological awareness Phonemic awareness Alphabetic knowledge Morphology
Picture word prompts	Assesses sentence writing 3-min administration Group or individual administration Common scoring metrics: words written, words spelled correctly, correct word sequences, correct minus incorrect word sequences	Sentence-level skills Grammar and mechanics Spelling
Story prompts	Assesses paragraph or discourse-level writing 3-min administration Group or individual administration Common scoring metrics: same as Picture Word	Paragraphs or connected text Grammar and mechanics Spelling
Common Scoring Metrics		
<i>Words written:</i> Total number of words written; a “word” is a sequence of letters separated by a space from another sequence of letters ^a		
<i>Words spelled correctly:</i> Number of correctly spelled words regardless of the context ^a		
<i>Correct letter sequences:</i> Any two adjacent letters that are placed correctly in a dictated word ^b		
<i>Correct minus incorrect letter sequences:</i> Number of correct letter sequences minus incorrect letter sequences		
<i>Correct word sequences:</i> Any two adjacent words that are spelled and used correctly in context ^a		
<i>Correct minus incorrect word sequences:</i> Number of correct word sequences minus incorrect word sequences		

Note. CBM = curriculum-based measurement.

^aDefinition consistent with Parker et al. (1991).

^bDefinition consistent with Videen et al. (1982).

common practice to work to advance a student’s skills to at least the 50th percentile at the level at which the child’s progress is being monitored, which may be below the student’s grade level. Using a computer-based graphing system such as Microsoft Word (e.g., insert charts) or Excel, the student’s median base- line score and the targeted end-of-year benchmark can be plotted (if available) or use a provided normative growth rate to calculate a long-term goal. To calculate a weekly growth rate based on a provided end-of-year benchmark, subtract the student’s median baseline score from the end-of-year bench- mark and divide the result by the number of weeks remaining in instruction. To calculate a long-term goal based on a normative growth rate, multiply the normative

growth rate by the number of weeks remaining in intervention and add this result to the student's median baseline score. Figure 2 provides the formula and an example for determining an end-of-year benchmark and a normative growth rate.

End of year benchmark:

$$\frac{\text{End of Year Benchmark} - \text{Median Baseline Score}}{\text{Number of Weeks Remaining}}$$

Ex.

$$\frac{(37 \text{ CWS} - 10 \text{ CWS})}{(30 \text{ Weeks})} \rightarrow \frac{(27 \text{ CWS})}{(30 \text{ Weeks})} \rightarrow 0.90 \text{ CWS/Week}$$

Using an end of year benchmark of 37 CWS (50th percentile for second grade on a picture word prompt), and with 30 weeks remaining to progress monitor, the student needs to grow 0.90 CWS/week to meet the end of year benchmark of 37 CWS. (Note: In the vignette, 37 CWS is the long-term goal Mrs. Baldwin selected for Kelly. This example also uses Kelly's median baseline score of 10. If Mrs. Baldwin has 30 weeks remaining to progress monitor Kelly, she will expect Kelly to grow by 0.90 CWS/week in order to meet the end of year benchmark.)

Normative growth rate:

$$(\text{Normative Growth Rate} \times \text{Number of Weeks Remaining}) + \text{Median Baseline Score}$$

Ex. $(1.5 \text{ CLS} \times 35 \text{ weeks}) + 75 \text{ CLS} \rightarrow (52.5 \text{ CLS}) + 75 \text{ CLS} \rightarrow 127.5 \text{ CLS}$

Using a normative growth rate of 1.5 CLS/week (on a word dictation prompt), and with 35 weeks remaining to progress monitor, the student is expected to reach an academic goal of 127.5 CLS.

Figure 2. Setting long-term goals.

Note. CWS = correct word sequences; CLS = correct letter sequences.

If an end-of-year benchmark or a normative growth rate is not available or is considered inappropriate for the student, such as a student with significant intellectual disabilities, alternative goal setting methods are available but should be used cautiously. When information on peers' levels of growth is available, the teacher may use peer data to identify an adequate end-of-year goal. For example, a teacher may identify an end-of-year score for students scoring at the 25th percentile for *correct letter sequences* (CLS) on a word dictation prompt or for correct word sequences (CWS) on a picture word prompt and story prompt. Alternatively, the teacher may determine the rate of growth for the student's current level of performance (e.g., 10th percentile) and determine a growth rate that is higher than the current growth rate. To determine a higher rate of growth, the teacher can multiply the current rate by 1.5 or 2 (Salvia et al., 2017). Regardless of how the long-term goal is calculated, it is important to ensure that the goal (a) is attainable within the specified time frame, (b) provides an adequate level of challenge, and (c) is "an appropriate target for instruction" (Salvia et al., 2017, p. 156). Most importantly, long-term goals are not intended to be reduced or simplified just because a student is

struggling. If the long-term goal was appropriately specified based on the student's level of needs, instructional and pedagogic practices should be altered to help ensure the continual growth of the student's writing skills.

Because Mrs. Baldwin needed to set an ambitious long-term writing goal for Kelly, and the researcher-developed probes came with norms, she selected the 50th percentile score for CWS at the second-grade level given that Kelly's current performance was around the 10th percentile in the Fall.

Step 3: Implement High-Quality Instruction With Fidelity

It is imperative to select evidence-based practices to support students' written expression needs. However, teachers must ensure that they are selecting interventions that are uniquely matched to students' individual needs and that match interventions with sufficient evidence for use with the population of students with whom each teacher works. Table 2 provides resources that teachers might access when they are looking for evidence-based instructional practices to support their struggling elementary writers with and without learning and emotional disabilities.

In a best-evidence synthesis of early writing interventions, McMaster et al. (2018) identified two key findings. First, explicit, systematic instruction for students in handwriting and spelling improved performance in both these skills, along with the quantity and quality of writing. Second, instruction in text generation and self-regulation through the self-regulated strategy development (SRSD; Graham et al., 2013) model resulted in improved writing composition. Thus, early elementary writers and writers still working to develop word-level skills may require instruction in handwriting (see Graham et al., 2000)—focusing on letter formation, fluency, pencil/pen grasp, and fine-motor skills. They may also need instruction in spelling (Graham et al., 2012), including phonological awareness, alphabetic awareness, spelling patterns and rules (e.g., long vs. short vowels, silent e), and morphological awareness.

Table 2. Evidence-Based Writing Practices and Assessment Resources for Teachers.

Resource	Notes
What Works Clearinghouse (https://ies.ed.gov/ncee/wwc/)	See specifically the practice guide <i>Teaching Elementary School Students to be Effective Writers</i> .
Intervention Central (https://www.interventioncentral.org/)	See specifically the link on academic interventions that provides several resources on supporting writing, as well as the writing probe generator for story prompts.
National Center for Intensive Interventions (https://intensiveintervention.org/)	See specifically the Academic Intervention Chart under the Tools Charts tab.
CEEDAR Center for Evidence-Based Practices for Writing Instruction Guide (http://ceedar.education.ufl.edu/tools/innovation-configuration/)	An electronic guide outlining 36 evidence-based instruction and assessment writing practices.
Writing Next: Effective Strategies to Improve Writing of Adolescents in Middle and High Schools Report (https://www.carnegie.org/publications/writing-next-effective-strategies-to-improve-writing-of-adolescents-in-middle-and-high-schools/)	This report discusses 11 teaching strategies for supporting the writing needs of students in Grades 4–12.
Early Writing Project (https://earlywritingproject.org/)	A collaborative project between researchers at the University of Minnesota and the University of Missouri focusing on professional development for teachers to build capacity in using data-based instruction by providing tools, learning, and coaching.
Sentence Writing: Materials for Instruction and Practice (http://shawndatchuk.com/)	This website provides free curriculum materials (including instructional lessons and practice sheets) for improving students' sentence writing skills.
AIMSweb (https://www.pearsonassessments.com/professional-assessments/digital-solutions/aimsweb/about.html)	AIMSweb provides screening and progress-monitoring curriculum-based measures in reading, writing, and math.

Writers who are working to develop sentence and more advanced passage/paragraph-level skills may require support in using initial capitalization and end punctuation, understanding the difference between a complete sentence and a fragment, and understanding sentence complexity, grammar, mechanics, and syntax. As students move into more advanced sentence-level skills, they may experiment with word choice and vocabulary, spelling, use of punctuation (e.g., dialogue), and coordinating conjunctions to form more complex sentences (e.g., sentence combining; Saddler, 2005). Graham et al. (2017) also found through a meta-analysis that students with LD scored lower than their typically achieving peers on these writing outcomes. Moreover, all interventions need to be implemented with fidelity to ensure the effectiveness of the intervention; otherwise it will be difficult to determine why some students may show inadequate progress.

After reviewing Kelly's in-class writing assignments and the sentences she produced on the CBM baseline probes, Mrs. Baldwin determined that Kelly was struggling with generating complex sentences and needed to improve her vocabulary knowledge. Kelly relied on simple sentence structures (e.g., I like dogs, I like apples) and misspelled long vowel sound words (e.g., bake, here, fire, nose, cute). Thus, Mrs. Baldwin developed a writing instructional plan consisting of sentence combining (Saddler, 2005) to help Kelly generate more complex sentences and word study (Graham et al., 2002) to teach specific spelling patterns during intervention time. Mrs. Baldwin selected these interventions after considering Kelly's current skills against the state writing standards and her Individualized Education Program (IEP) goals in writing, and suggestions in the practice guide on elementary writing issued by the What Works Clearinghouse (Graham et al., 2012). For example, Mrs. Baldwin knew that Kelly was capable of writing simple sentences, and to meet her long-term goal of increasing the complexity of her sentences, Kelly would need interventions that explicitly teach how to build compound and complex sentences. What Works Clearinghouse guide activities, like sentence framing or sentence expanding, target creation of basic simple sentences and would probably be too easy for Kelly. Mrs. Baldwin decided that sentence combining was the right intervention for Kelly because this strategy addresses how to create longer, more sophisticated sentences, which fit with Kelly's goals and ability level. Mrs. Baldwin delivered this instruction in small groups for 30 min three times a week. She made a self-checklist to examine her fidelity of writing instruction and completed the checklist after each instructional session.

Step 4: Monitor Progress Toward the Goal

Using the CBM task identified in Step 1, teachers should continue to monitor student progress on a regular basis following the standardized administration and timing rules, typically at least once per week for students with intensive academic needs and/or with learning or emotional disabilities in writing. After each administration, it is important to score the student's probe, plot the student's score on a graph, and store and organize assessment materials. Some students may find it motivating to help with scoring and graphing as reinforcement for making progress. While picture word and

story prompts can be individually or group administered, most progress monitoring is completed individually (e.g., 1:1 with the teacher; see also Table 1).

Each week, Mrs. Baldwin monitored Kelly's writing progress using picture word prompts that she administered individually to Kelly; Mrs. Baldwin scored the writing samples using CWS and plotted the data on Kelly's graph. See Figure 3.

Step 5: Use Decision Rules to Determine Effectiveness

After collecting and plotting approximately 8 to 10 data points, teachers examine the level, trend, and variability of the data. *Level* refers to the placement of students' data in relation to the goal line (e.g., mostly above, below, or on the line). *Trend* refers to trajectory of a student's growth in writing or the student's performance over time. The student's rate of growth is demarked with a trend line, which is compared with the goal line (e.g., steeper than [above] the goal line, flatter than [below] the goal line, or even with the goal line). *Variability* refers to the amount of bounce within the data and may be evident in extremely high or low scores. Examination of level, trend, and variability will help direct the teacher in making a decision about the student's progress.

Three options exist when making an instructional decision based on progress monitoring data. First, if a trend line is above the goal line, the teacher would increase the long-term goal. Second, if a trend line is below the goal line, the teacher would change instruction. Third, if the trend line is even with the goal line, the teacher would continue current instruction. However, while the direction of the trend line is important, it is also important to consider the placement of the data points (i.e., level) in thinking about why the trend line appears as it does, as well as the extent to which any highly variable data points may skew the trajectory of the trend line.

While most electronic graphing systems have options for automatically inserting a trend line, manual methods exist for calculating a trend line (Hosp et al., 2016; National Center on Response to Intervention, 2013). After collecting at least eight data points, divide the data as evenly as possible into three groups. For example, divide a set of eight data points into an initial group of three, a middle group of two, and a final group of three. Identify the median value of the first and final group and the middle week

of each and mark each with an X. Then connect the two Xs with a line. This line becomes the student's trend line and can then be compared with the goal line.

After collecting and plotting eight data points, Mrs. Baldwin found that four of the eight data points were below the goal line, the trend was flatter than the goal line, and there was some variability. See Kelly's CBM graph in Figure 3 (especially Intervention 1). Thus, Mrs. Baldwin decided to change her instruction to help support Kelly.

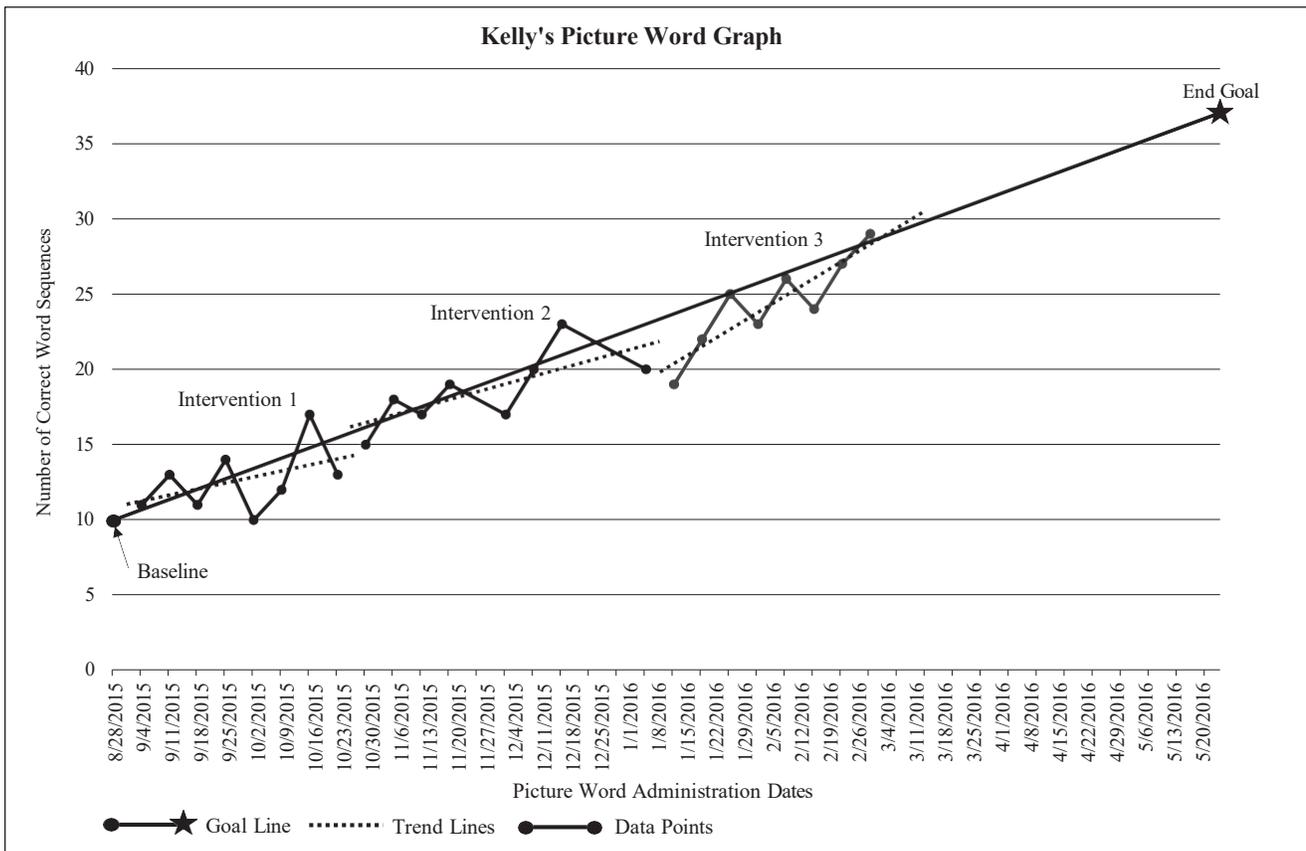


Figure 3. Kelly's curriculum-based measurement writing graph.

Step 6: Generate a New Student Progress Hypothesis

To further refine instruction, teachers need to reflect on their current set of practices. First, teachers ask three questions for self-check: (a) whether writing instruction was supported by research, (b) whether they implemented the writing instruction with adequate fidelity, and (c) whether the student received an adequate

dosage of writing instruction suggested by research. If teachers answer “yes” to each of these three questions, the teacher hypothesizes about why the student did not show adequate response to the current writing instruction. If teachers respond “no” to any one of the questions, they must first correct the error and collect more data. Hypotheses might include that the student needs more time in intervention, targeted skill or content practice, opportunities to practice, or explicit instruction. Alternatively, a student might need a change in the focus of the intervention, support with motivation or attention, environmental changes, or other instructional, pedagogical, or environmental changes (McMaster & Lembke, 2014). These hypotheses can be described as quantitative (e.g., change dosage or time, change the learning environment) or qualitative (e.g., combine cognitive processing strategies with academic learning and modify delivery of instruction; The IRIS Center, 2015; National Center on Intensive Intervention [NCII], n.d.-a). Moreover, L. S. Fuchs et al. (2017; see also NCII, n.d.-b) developed a Taxonomy of Intervention Intensity that can be used for supporting and adapting the intensity of intervention implementation. The taxonomy addresses evidence of effectiveness, dosage, alignment with instruction, generalization of skills, the comprehensiveness of the intervention, and behavioral and academic supports. Teachers are also directed to the NCII website (<https://intensiveintervention.org>; see specifically the intervention materials tab) which includes several tools to support intensification.

Because Mrs. Baldwin answered “yes” to the three self-check questions, she tried to hypothesize why Kelly did not show adequate response to the current writing instruction. Mrs. Baldwin often noted that Kelly was distracted within the small group and needed more direct and individualized attention. Thus, Mrs. Baldwin hypothesized that Kelly would make better progress if she worked with her individually rather than in a small group.

Step 7: Implement an Instructional Change

Based on the hypothesis generated at Step 6, the teacher makes decisions about necessary instructional changes. Providing that appropriate skills have been

identified for remediation and that the tools match the targeted needs, the CBM tool itself should not be changed to ensure that potential changes in student performance are not a function of a change in measurement tool.

Based on the hypothesis that she generated at Step 6, Mrs. Baldwin worked with Kelly individually, tracking her performance every week (see Intervention 2 in Figure 3).

Step 8: Repeat Steps 4–7 as Necessary

If a student is not responding to presented instruction, teachers repeat the process from Steps 4 to 7 as needed each time the student does not respond to instruction. See the middle dashed line in Figure 1 showing how the DBI cycle continues.

Mrs. Baldwin will repeat the process each time Kelly does not respond to instruction. She examines Kelly's writing performance after collecting eight additional data points and makes an instructional decision based on the available data.

Conclusion

Schools and local education agencies are increasingly requiring general and special education teachers, like Mrs. Baldwin, to use data to support instructional decisions for their struggling learners and students with learning and emotional disabilities. Data-based instruction offers one way for teachers to use data to inform individualized writing instruction. Mrs. Baldwin found that the individualized instruction helped Kelly, a student with LD, but that she also needed to involve Kelly in graphing her scores. With Kelly now meeting with greater success in writing (see Intervention 3 in Figure 3), Mrs. Baldwin is confident that the DBI framework can help her improve her instruction and assessment practices to support all of her learners with learning and emotional disabilities.

Declaration of Conflicting Interests

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Note

1. The vignette referenced in this manuscript is a fictionalized account drawn from several authentic research situations and put together as an aggregated scenario.

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