Systematic Instruction in Phoneme-Grapheme Correspondence for Students With Reading Disabilities

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Abstract

Letter-sound knowledge is a strong predictor of a student's ability to decode words. Approximately 50% of English words can be decoded by following a sound-symbol correspondence rule alone and an additional 36% are spelled with only one error. Many students with reading disabilities or who struggle to learn to read have difficulty with phonology, an understanding of how sounds are organized within language. This can result in difficulty grasping the alphabetic principle, the knowledge of the relation between speech sounds and the letters/letter patterns that represent them. Research has demonstrated the benefits of intensive, explicit instruction for developing struggling readers' capacity to identify phonemes and apply knowledge of phoneme-grapheme correspondence for decoding. In this article, common misconceptions and basic tenets of effective letter-sound instruction are provided to help special educators and reading interventionists plan for effective phoneme-grapheme correspondence instruction for students with reading disabilities or who are at risk for reading failure.

Alphabet knowledge is a fundamental building block of literacy instruction. Alphabet knowledge consists of students' familiarity with letter forms, names, and associated sounds (Goldberg & Lederberg, 2015; Piasta & Wagner, 2010a). Of these skills, student capacity to accurately and fluently produce the sounds associated with letters is directly related to skill in decoding and is one of the strongest predictors of later reading achievement (Hammill, 2004; Huang, Tortorelli, & Invernizzi, 2014; Jones, Clark, & Reutzel, 2013; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004). Yet recent research has demonstrated inconsistencies in the delivery of letter-sound instruction and limited efficacy of many letter-sound instructional approaches (Piasta & Wagner, 2010b). Although letter-sound knowledge is a foundational skill upon which more complex literacy development occurs, many current practices fall short of meeting many students' needs in this area. For students who have specific deficits in phonological memory and processing (i.e., reading disabilities or dyslexia), explicit instruction in consonant and vowel sound-spelling correspondence is of particular importance

(Torgesen, 2005). Strong letter-sound awareness facilitates decoding and promotes accurate spelling (Caravolas, Hulme, & Snowling, 2001). Research on letter-sound development and instruction has generated a set of overarching principles and specific recommendations that teachers, special educators, and reading interventionists in particular can apply within their own context to boost student letter-sound knowledge and skills that can then be connected to more complex orthographic instruction (Snowling & Hulme, 2011).

Letter-Sound Misconceptions

For many kindergarten and first-grade teachers, letter-sound instruction is a key component of beginning reading instruction. Traditional approaches, however, may not be the most

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Format 1: Sound Practice Only	**Today, we are going to learn a new sound.**
	[Point to the letter *m* written on the board or hold up a card with the letter *m*.]
	Model: **My turn**. [Place your hand on your chest to indicate students should be watching and listening.] /**mmmmm**/
	Lead: **Now, say the sound with me.** [Drop your hand so that it is open towards the students.] /**mmmmm**/
	Test-Whole Group: [Hold your hand up to signal silence.] **Your turn.** [Drop hand as students respond, /mmmmm/.]
	Test-Individual Turns: **Individual turns.** [Point to the letter, call student names.]
	*Practice with previously learned sounds and fold the new sound into the review.
Format 2: Sound Practice with Keyword	**Today, we are going to learn a new sound. This is the sound for the letter *m*.**
	[Point the letter *m* on the board.]
	Model: Listen, **"m – man - /mmm/"** [State the letter name, then the keyword, then the sound.]
	Lead: **Now, say it with me: "m – man - /mmm/."**
	Test-Whole Group: **Your turn. Wait until I point to the letter.** [Students state: "m – man - /mmm/."]
	Test-Individual Turns: **Individual turns.** [Point to the letter, call student names.]
	*Practice with previously learned sounds and fold the new sound into the review.

Figure 1. Two Formats for Using the Model-Lead-Test Framework for Letter-Sound Instruction.

efficient or effective, particularly for students at risk for reading difficulty (Jones et al., 2013; Justice, Pence, Bowles, & Wiggins, 2006; Piasta & Wagner, 2010b). For example, one practice typically employed is the *one-letter-per-week structure* (Huang et al., 2014; Huang & Invernizzi, 2014; Justice et al., 2006). This approach lacks efficiency because some letters (e.g., vowels *i, o,* and *e* and consonants *y, w,* and *c*) require more attention, practice, and effort to learn than others (Huang et al., 2014; Stahl, 2014). In addition, some teachers and reading programs follow alphabetical order. The *alphabetical order* approach is not optimal as it

- can delay the application of letter sounds to decoding (e.g., teaching the letters *m, a, t,* and *s* allows for immediate decoding practice of words like *mat, sat, am, at,* and *Sam*) and
- does not allow for scaffolded instruction (i.e., teaching easier sounds before challenging sounds and separating the instruction of similar sounds) (Carnine, Silbert, Kame'enui, & Tarver, 2010).

Similarly, some teachers and programs will teach letter sounds using either all capital letters or a mix of both capital and lowercase letters. As the majority of letters students will encounter for decoding are lowercase (Huang & Invernizzi, 2014), some scholars recommend beginning with lowercase letters and slowly adding uppercase letters after students have mastered letter-sound correspondence with lowercase letters (Bursuck & Damer, 2015; Carnine et al., 2010).

Phoneme-Grapheme Mapping

Students with disabilities often require more intensive instruction along with abundant repetition than do their typical peers

(Daly, Martens, Barnett, Witt, & Olson, 2007; Handler & Fierson, 2011; Jones et al., 2013). For these students, direct, explicit, systematic instruction is ideal for discrete skill development like proficiency in phoneme-grapheme mapping (Moats, 2009; National Reading Panel, 2000). The general principles of direct, explicit, and systematic instruction can be directly applied to the instruction of phoneme-grapheme mapping.

For phoneme-grapheme mapping instruction, *direct* teaching involves the identification of the specific concept or skill is to be taught and the tools for teaching. For example, when teaching challenging sounds such as the short (lax) *a* sound, a teacher may use magnetic letters (Pullen & Lane, 2014) or flashcards with a sound and keyword picture on it as a method of direct teaching. Similarly, *explicit* instruction would involve planning for precise language and format for initial instruction:

> "First I will say the letter name, a keyword for the sound, and then the sound. Next we will say it together, and then it will be your turn. My turn—*a*, apple, /a/. Together—*a*, apple, /a/. Now your turn. (*a*, apple, /a/) Great job!"

This script exemplifies a model-lead-test format, which many educators and instructional programs use for explicit teaching (Bursuck & Damer, 2015). The model-lead-test format is brief and allows students the opportunity to see and hear an example of correct letter-sound mapping (model), practice with teacher guidance (lead), and then produce the sound independently (test). In Figure 1, two examples of the model-lead-test format are provided; one involves a letter sound only, and the other includes the use of a keyword. After this type of initial instruction, distributing practice in which students retrieve the sound independently is important for long-term learning (Jones et al.,

Table 1. Consonant Production Based upon Location.

Type of Obstruction	Consonant Sound
Lips	/p/ /b/
Lips/teeth	/f/ /v/
Tongue between teeth	/th/ /th/
Tongue behind teeth	/t/ /d/; /n/; /s/ /z/; /l/
Roof of mouth	/sh/, /zh/; /ch/ /j/; /y/; /r/
Back of mouth	/k/ /g/; /ng/; /wh/ /w/
Throat	/h/

Table 2. Categories of Vowels and Corresponding Vowel Sounds.

Phonics Terminology	Phonetics Terminology	Vowel
Long	Tense	ā, ē, ī, ō, ū
Short	Lax	ă, ĕ, ĭ, ŏ, ŭ
	Diphthongs	oy, ow, igh

Note: There are also "r-controlled" vowels such as er, or, and ar.

2013). Finally, *systematic* phoneme-grapheme mapping instruction would involve deciding which letters to teach and in what order, the appropriate assessments to employ to monitor student mastery, and how phoneme-grapheme mapping instruction will transfer to decoding skills. To deliver effective instruction, an understanding of the building blocks (i.e., consonants and vowels) as well as a plan for developing an instructional scope and sequence are key.

Consonants and Vowels

A strong understanding of consonants and vowels can facilitate clear, accurate instruction. Specifically, understanding

- the difference between consonants and vowels,
- how they are produced, and
- how small changes in production can result in different phonemes may help teachers plan for the specific remediation of student deficits (Moats, 2010).

Consonants are produced when air is obstructed by the lips, teeth, and tongue. For example, obstruction by the lips produces the /b/ and /p/ sounds. The teeth and tongue work together to produce /f/ and /v/ sounds. In addition, consonants can be *voiced* (i.e., produced with vocal cords vibration; /d/, for example), or *unvoiced* (i.e., produced with no vibration as with /t/). Understanding where and how consonants are produced can help teachers clarify student confusion due to similarity of place of articulation. For example, to facilitate students' recognition of the difference between voiced and unvoiced sounds, teachers can have students touch their throats or hold a hand in front of the mouth to feel the difference between consonants such as /t/ (no vibration) and /d/ (vibration) during letter-sound production. Production of the /t/ sound will result in breath leaving the mouth but no vibration from the throat. Conversely, production of the sound /d/ will result in vibration from the throat but little or no breath leaving the mouth. See Table 1 for an overview of consonant pronunciation based upon location.

Vowels, in contrast, are open sounds that are produced with no obstruction. Vowels are always voiced (e.g., /ā/, /ĕ/,

/ĭ/). Many phonics programs categorize vowels as long, notated by the macron [ā], or short, notated by the breve [ĕ]. This characterization is technically incorrect, however, as duration of vowel sound varies based upon the word in which it is used; in addition, there is a third category of vowels called diphthongs (Moats, 2010). In contrast, linguists refer to "long" vowel sounds as *tense* and "short" vowel sounds as *lax*. To be consistent with most reading programs, though, the terms *long* and *short* will be used within this article. When teaching vowel sounds, teachers can provide a mirror in order for students to see correct mouth placement. The mouth will move from a wide smile when pronouncing /ē/ to an open circle for /ŏ/ to small tight circle for /ō/. In Table 2, the categories of vowels and their corresponding vowel sounds are provided.

Scope and Sequence for Mapping

To begin planning for phoneme-grapheme mapping instruction or intervention, Carnine et al. (2010) recommended beginning with a small set of letter-sound correspondences. Once these correspondences are mastered, students can practice blending and segmenting these sounds in the application of decoding vowel-consonant (VC) and consonant-vowel-consonant (CVC) words prior to introducing additional sounds. By employing this approach to phoneme-grapheme mapping instruction, the relation between isolated letter-sound mapping and decoding is made explicit. In other words, teachers quickly demonstrate to students that knowledge of letter sounds is used for decoding words. Gildroy (1999) offered these guidelines for the selection of letter sounds:

- Teach the most common sounds before introducing alternate sounds (e.g., *c* as in "cat" prior to *c* as in "city").
- Initially separate the teaching of letters that are visually similar (e.g., *p, b, g, d,* and *q; m* and *n;* and *v* and *w*).
- Teach letters that are used more frequently prior to letters that are used less frequently (e.g., the letters *m, s, t, r, a,* and *f* are used more frequently than *z, v,* and *q*).

In Table 3 a sample scope and sequence that adheres to these basic guidelines is provided. The sample scope and sequence also addresses several other considerations for letter-sound instruction (Bursuck & Damer, 2015; Carnine et al., 2010; Vaughn & Linan-Thompson, 2004). First, consonants tend to be easier for students to learn as there is typically only one sound associated with each consonant. Second, continuous sounds, sounds that can be produced as long as one's breath (e.g., /m/, /s/, /f/, /ā/), are easier for students to produce than stop sounds (e.g., /d/, /t/, /p/, /g/; Bursuck & Damer, 2015). Finally, short vowel sounds should be taught prior to long vowel sounds (Carnine et al., 2010). Therefore, the introductory set of phoneme-grapheme correspondences will include more consonants than vowels, contain more continuous sounds than stop sounds, and address short vowel sounds prior to long vowel sounds.

Another important consideration in developing a scope and sequence is the need to help students understand the connection between phoneme-grapheme production in isolation and during decoding. As the purpose of letter-sound instruction is to facilitate decoding, the sooner students can apply their knowledge of letter sounds to actual reading, the better. Therefore, an important part of phoneme-grapheme mapping instruction includes decoding work, that is, blending and segmenting sounds. After students have gained facility with the initial set of phoneme-grapheme correspondences, the next step in the sequence is to provide application opportunities using VC and CVC words (e.g., *at, mat*). Providing students with opportunities to apply phoneme-grapheme mapping skills to nonsense word decoding further reinforces pattern recognition. The pairing of phoneme-grapheme mapping instruction both in isolation and with decoding facilitates students' understanding of the alphabetic principle, the understanding that words are composed of letters that represent speech sounds. Once students have demonstrated the ability to sound out VC and CVC words composed of letters from the initial teaching set, teachers can repeat the process with a new set of letter sounds.

At this point in instruction, it is important to consider when and how to teach irregular words, those whose sounds are unique to that word or less commonly applied to the letters or letter pattern (e.g., *was, have, is*). Many teachers teach irregular words along with regular, high-frequency words as whole words (e.g., using flashcards); these are commonly referred to as *sight words* (Erwin, 2016; Musti-Rao, Lo, & Plati, 2015; Sullivan, Konrad, Joseph, & Luu, 2013). Any word that can be read automatically may be considered a sight word, but in the common vernacular of teachers, sight word instruction typically is equivalent to whole-word instruction. However, teaching irregular words prior to decoding instruction can lead to the misconception that reading involves only automatic, whole-word recognition. Students with this misconception may see the word "bake" and guess "bike" or "back" by applying their knowledge of the initial letter but not understanding how to decode the word. Therefore, to avoid confusion, introduce irregular words as exceptions when teaching orthographic patterns such as CVC (e.g., exception = was) and CVCe (consonant-vowel-"silent e"; e.g., exception = have) rather than introducing exceptions prior to or in conjunction with early letter-sound instruction. To reinforce the concept that these words are exceptions, some teachers will call them *outlaw words* and use different strategies (e.g., flashcards) or materials (e.g., gel pads). An excellent list of phonetically irregular words can be found in *The Reading Teacher's Book of Lists* (Fry & Kress, 2006).

After all single letter sounds and a set of irregular words are taught, students will be ready for more advanced phoneme-grapheme mapping instruction, which includes the teaching of

- letter combinations (e.g., consonant blends, digraphs, trigraphs, VC combinations, r-controlled sounds)
- rules that guide letter pronunciation (e.g., the VCe or "magic e" rule), and
- special cases such as silent letters, multiple letter sounds (e.g., soft "c" and "g").

How this more advanced orthographic instruction connects to initial letter-sound instruction is presented in Table 3.

Distributed Practice

As students progress through the identified sequence of instruction, distributed practice is particularly important for students who have disabilities or who are at risk for reading failure (Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006; Jones et al., 2013). Distributed practice refers to spaced learning trials over time, which facilitates long-term retention more effectively than massed learning in a single trial (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013). Specifically, Jones and Reutzel (2012) found that distributed review cycles of alphabet knowledge instruction significantly reduced the number of students identified as at risk for reading failure when compared to students who received traditional letter-per-week instruction. Therefore, students may learn and retain more letter-sound correspondences when repeated review of previously learned letter sounds is incorporated into instruction of new sounds and patterns. Continual review safeguards against forgetting and reduces students' confusing rules and sounds. Thus, a revolving door of instruction begins to take effect. The cycle begins with the teaching of a subset of phoneme-grapheme correspondences. As some correspondences are mastered, they are dropped out of focus, and others revolve in. The continual movement in and out allows for the

Table 3. Possible Scope and Sequence for Letter-Sound and Beginning Phonics Instruction.

Focus of Instruction (Depending upon student skill, each step in the sequence can take several weeks or more for mastery.)	Letter-Sound Correspondence	Phonics Application (possible words[a])
1st: Initial set of consonants and short vowel sounds	*m, s, a, t, r, i, f*	*it, mat, at, sat, fit, sit, if, rat*
2nd: More consonants and short vowels	*n, d, o, h, l, g*	*on, dig, had, hat, him, mad, fog, tag, sad, nod, lid, fig, log, tin*
3rd: Introduction of irregular words		*is, the, has, are, was, to*
4th: More consonants and short vowels *Irregular word instruction continued…*	*b, u, c, k, w*	*bat, mud, hug, kit, cab, win, fib, tab, cat, wit, kid, wag, big*
5th: Final set of consonants and vowels *Irregular word instruction continued…*	*p, j, e, v, y, z, qu*	*mop, jab, web, cop, sip, quiz*

After single consonants and short vowels are mastered, students are ready for letter combinations and a deeper understanding of the rules and patterns that govern the production of sounds and the spelling of words. Next is an overview of content to be taught after single letter-sound instruction.

6th: Letter combinations		
• Consonant digraphs & trigraphs	• *ch, th, wh, sh, ck, ph, -ng, tch*	• *chin, when, shed, kick, graph, itch*
• Consonant blends	• *st, sp, dr, fr, cr, sl, br, gr, fl, scr, str*	• *step, spot, drip, last, frog, drum, must, green, scrap, slip, strep*
• Double ending consonants	• *ff, ll, ss, zz*	• *spill, fluff, pass, fizz*
• Letter combinations	• *all, an, am, ing, al, ol*	• *fall, fan, ham, sing, halt, bold*
• Vowel digraphs	• *ai, oa, ou, ea, oy, aw, au, ee, oo, ay, oi, ow, eu, ew, ie, ei, ui*	• *day, beat, bait, toad, creek, boot, eat, pie, suit, few, food, draw, haul, soil, toy, loud, cow*
• r-controlled sounds	• *ar, or, er, ir, ur*	• *car, doctor, fern, bird, fur*
7th: Rules that guide letter pronunciation	*VCe (vowel-consonant-"silent e")* or *"Magic e" rule, open syllables, suffixes (-s, -ed, -ing, -ful), prefixes (un-, a-, re-, de-)*	*game, pipe, me, baby, acorn, nobody, she, watched, filled, shopping, unable, retake, pretest*
8th: Soft "c" and "g" sounds; silent letters; stable final syllables	*c- and g- followed by i, e, or y; gh, gn, kn, mb, mn, rh, wr, -tion, -sion, -ture, consonant -le*	*city, cycle, gym, gem, face, nice, page, badge, know, write, ghost, mention, capture, sparkle, ripple, table*

a. This is not an exhaustive list of decodable words that can be used for instruction; rather it is a small sample of possible words.

introduction of new letter-sound correspondences and the repetition (i.e., distributed practice) of previously learned ones during instruction. For example, students may begin by working on a subset of letter sounds (3–5) in isolation and then practice reading and writing words that contain those sounds (i.e., decoding and encoding). Once students become comfortable reading and writing the letter sounds in single words, opportunities for students to read decodable, connected text reinforces pattern recognition and begins the process of developing fluent reading (Stahl, 2014). Finally, previously mastered letter-sound correspondences and/or trouble spots are reviewed as a new subset of letter sounds is introduced, and the cycle is repeated.

Assessment

Once teachers have determined which sounds to teach and how, periodic assessment of student progress allows for appropriate pacing of instruction. Curriculum-based measurement (CBM) is a commonly used method of data

collection for the purpose of monitoring student progress (Fuchs & Fuchs, 2011). Brief CBM assessments are available from a variety of sources including DIBELS (https://dibels. uoregon.edu/), FastBridge (http://www.fastbridge.org/early-reading/), AIMSweb (http://www.aimsweb.com/), and easyCBM (https://www.easycbm.com/) as well as others. When implementing CBM, it is important to follow the guidelines for administration consistently in order to generate reliable results. Early-literacy probes from easyCBM include letter names, letter sounds, phoneme segmenting, and word-reading fluency (Alonzo, Park, & Tindal, 2013). The easyCBM letter-sound probes consist of single letters and letter combinations (e.g., digraphs) appearing in varied sequences. Administering one probe prior to beginning letter-sound instruction will determine students' present level of performance. Additional probes can be administered periodically (e.g., weekly, biweekly, monthly) for the purpose of monitoring student progress. An example is provided in Table 4, with step-by-step directions for implementing the easyCBM probe.

Table 4. Directions for Implementing easyCBM® Letter Sounds Probe for Progress Monitoring.

Step	Material
1. Create an easyCBM® account (free).	• https://www.easycbm.com/
2. From the dashboard, select *Measures*.	
3. Select the appropriate grade level (e.g., K or 1).	
4. Under the category of *Reading*, select LS (Letter Sounds).	
5. Select and print student and assessor materials.	• Assessor copy (with instructions); student master copy (make copies for the number of students to be assessed)
6. Review directions for assessment administration and scoring.	
7. Gather your materials for the one-on-one assessment, and identify a quiet space to conduct the assessment.	• Stopwatch (all Letter Sounds probes are 1 min) and marking instrument (pen or pencil)
8. Conduct the assessment.	
9. Score the assessment and graph students' scores.	
10. *Optional*: Create a class list in order to enter students' score and generate reports via the easyCBM® website.	• The *Students* section of easyCBM®—the green (+) symbol will allow you to enter new students, and the blue pencil icon will allow you to create learner profiles.
11. Use the Percentile Table to determine how your students scored in comparison to a national sample.	• *Detailed Percentile Table* (pdf)

Barriers to Letter-Sound Instruction

Delivery of effective letter-sound instruction requires knowledge of specific strategies as well as an understanding of potential barriers and pitfalls. Some of these barriers stem from lack of teacher knowledge of basic language structure (Joshi et al., 2009; Moats, 2009). For example, teachers may pronounce sounds incorrectly (e.g., pronouncing the short vowel sound of the letter *a* as "ah") or generate incorrect examples (e.g., VCe rule = bore). An awareness of possible impeding factors and their implications for letter-sound instruction will equip teachers to engage in deliberate planning and accurate instruction.

Teachers may impede students' capacity to blend by unknowingly producing letter sounds incorrectly (Sayeski, Gormely Budin, & Bennett, 2015). One common error can be the accidental inclusion of the *schwa* in conjunction with consonant production. The schwa is the unstressed vowel sound pronounced "uh" in words like *other, experiment*, and *again* (Drake & Ehri, 1984). Consonants, particularly stop sounds, such as /b/, /d/, /t/, and /p/ are especially susceptible to the pronunciation of the schwa sound. That is, teaching and repeating letter sounds incorrectly may inadvertently cause confusion and mispronunciation (e.g., student learns and practices /b/ as /buh/, thus incorrectly blending b-a-g to produce "bug").

Consistent production of letter sounds can facilitate students' accurate application to decoding. Teachers can refine their pronunciation of these letter sounds by listening to audio models from a reputable site (e.g., http://www.sightwords.com/phonemic-awareness/sound-pronunciations/) and practicing letter-sound production with a colleague. In addition, teaching stop sounds as "quick and quiet sounds"

(e.g., /b/, /d/) can reinforce the need to clip these sounds for crisp, clear letter-sound production. In contrast, stretch sounds (e.g., /ffff/, /mmm/) can be taught as "long and loud sounds."

In addition to the accidental incorporation of the schwa sound, the short vowel sounds of *e* and *i* can be particularly difficult to distinguish in spoken words; a distinction made even more difficult by regional accents. Teachers who make a concerted effort to emphasize tricky phonemes within words, especially decodable words such as *when, win, bend, bin*, and *bent*, which contain similar sounds, can expect to alleviate some inevitable confusion and promote greater spelling and reading achievement for their students.

Conclusion

Research on letter-sound instruction has demonstrated the efficacy of direct, explicit, and systematic instruction for students with reading disabilities or who experience difficulty learning to read. Brief, direct instruction in phoneme-grapheme mapping can yield positive gains for a wide range of learners (Piasta & Wagner, 2010b). An awareness of common misconceptions surrounding letter-sound instruction can allow teachers to provide more accurate instruction and prevent confusion among students. Finally, accurate letter-sound production allows teachers to serve as an appropriate model for learners. Educators may improve their ability to design and implement direct phoneme-grapheme mapping instruction by taking the time to master letter-sound production in isolation. This fine-tuning process has great potential to create a domino effect in which quality instruction facilitates students' accurate phoneme-grapheme mapping, thereby promoting strong literacy development.

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