The Evidence for a Comprehensive Algorithmic Approach for 21st Century Reading Instruction

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SUMMARY

Part 1: Research that Defines Reading

Decoding, Reading, and Reading Disability, Philip B. Gough and William E. Tunmer, 1986

The Simple View of Reading (SVR) posits that both Decoding and Comprehension play an indispensable role in Reading Comprehension.

We conclude the following: Decoding—which is separate from Comprehension—is integral to Reading. And because Decoding is not part of the naturally developing language instinct—Decoding must be taught.

A question remains: Is there a superior approach to teaching Decoding?

Part 2: Research that Explains How Decoding Should Be Taught

National Reading Panel Report (2000)

As the structure of the English writing system is alphabetic, decoding is most efficiently and successfully taught using phonics instruction. The NRP has thus put the Great Debate behind us, with Whole-Word and Whole-Language approaches a thing of the past, and phonemic awareness (PA) and phonics instruction an integral part of many reading curricula. But the NRP's indecision among the various types of phonics approaches, together with their insistence that phonics "is not the complete solution" (NRP 2-100) has left the door open to a new approach, one we refer to as a "Multiple Strategy" approach. Many of these strategies are not based on the latest research. Furthermore, the sheer number of strategies used to teach children to read can confuse the child in choosing which strategy to implement.

We conclude the following: A new phonics program should be devised, one that is based solely on the phonological unit that matters in English: the phoneme. For this new phonics program to be effective it should not employ "Multiple Strategies."

A question remains: Can a new research-based phonics program be created?

Part 3: A New Evidence-Based Approach

Diane McGuinness, Early Reading Instruction: What Science Really Tells Us about How to Teach Reading, MIT Press (Cambridge, MA), 2004

Diane McGuinness, Language Development and Learning to Read: The Scientific Study of How Language Development Affects Reading Skill, MIT Press (Cambridge, MA), 2005

McGuinness's theory is that Reading and Writing are two sides of the same "algorithmic process" (our term), and a phonics program is the only approach we know that allows for the teaching of this algorithm. But for this phonics program to be effective, it must be comprehensive and include the entire algorithm, and must not include elements that confound the algorithm. We explain how CAPIT Reading's "Singular Strategy" approach to reading instruction teaches the algorithm underlying the "English Alphabet Code" in its entirety without including elements that confound the algorithm.

Conclusion

Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching, Paul A. Kirschner, John Sweller, and Richard E, Clark. Educational Psychologist, 2006.

The authors of this study present "Evidence for the superiority of guided instruction."

We conclude the following: Reading instruction must be taught directly, explicitly, and with maximum guidance.

Introduction

Researchers generally don't build products. Conversely, entrepreneurs and product developers don't normally immerse themselves in research looking for inspiration on what product to build or guidance on how to build it. More often inventors tinker based on a heuristic. If their idea is validated by customers, then perhaps a future study will explain why it all worked. At best, a development team will consult the research throughout a long-term development project as they tinker with their product, and use the information to either change course, or abandon the project. That is how we would describe our relationship with the research. We first had an idea. We tested it, and it worked. We later found out that it was "research based," and the more we dug into the research, the more we learned how closely our product and the research were aligned. Then we hit a wall, and only when we uncovered some more research were we able to continue building our product.

Our product—CAPIT Reading—is certainly based on sound research, and at this point, we are no longer sure which ideas are our own, and which ideas we derived from reading a research paper or book.

We suppose that's how EdTech products should all be built.

Who knows.

Part 1: Research that Defines the Concept of Reading

Decoding, Reading, and Reading Disability, Philip B. Gough and William E. Tunmer, 1986

Please read the following:

> We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness. (Declaration of Independence)

How do lines and circles on the page (or screen) transform into "ideas" such as Liberty and Happiness?

Expert readers marvel, having forgotten how they learned to read so many years before. So let's put the *Declaration* aside, and read the following:

> CAT

When children read the word—and understand it—they are doing two things:

1. They look at the visual symbols (the letters C-A-T) and convert/**Decode** them into speech-sounds: /k/ /a/ /t/
2. Then, they use their language instinct, linguistic comprehension (vocabulary), and background knowledge, to **Comprehend**—make sense—of these **speech sounds**. They realize that when the sounds follow each other quickly they it all sounds like a word they know: cat. They might own a cat, or perhaps learned about cats. The more background knowledge they have about the word "cat," the more meaningful the reading of the word will be. Some will imagine an alley cat, some will imagine their own cat, others will think of all cats, still others might imagine an undomesticated cat such as a cheetah or a Bengali tiger. The word does not change, but the meaning changes based on the background knowledge of the reader.

If all this sounds banal and "simple" … well, it is, and that is why it is known as the **Simple View of Reading** (in short: SVR), introduced by Philip B. Gough and William E. Tunmer. SVR reduces reading to a simple equation:

$$R = D \times C$$

R stands for Reading. D stands for Decoding. C stands for Comprehension. If either D or C equals Zero, then R will also equal Zero. For Reading to occur, there must be Decoding as well as Comprehension (knowing what the word "cat" means). If Decoding is missing (D = 0), then no Reading will occur, even if the child is familiar with every breed of cat on earth. If Comprehension is missing (C = 0), then no Reading will occur, even if the child is an expert Decoder.

According to this framework, Comprehension without Decoding is Dyslexia, and Decoding without Comprehension is Hyperlexia. In other words, those who can Comprehend but cannot Decode are Dyslexic, and those who can Decode but cannot Comprehend are Hyperlexic.

To what degree do Decoding skills and Comprehension (oral language) figure in their contribution to the production of Reading comprehension?

Some researchers have found that for 1st and 2nd graders Decoding and Comprehension contribute equally to reading comprehension (Foorman, 2015). In regards to adult readers, researchers have found that the reading comprehension of better readers seems to be more constrained by limits on their oral language comprehension than on decoding skill, whereas limits on decoding figure more prominently in less skilled readers (see Braze, Katz, Magnuson, Mencl, Tabor, Van Dyke, Gong, Johns and Shankweiler, 2015).

Having reviewed the Simple View of Reading framework, let's return to the Declaration of Independence and reread it:

> We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness. (Declaration of Independence)

Clearly adults too must Decode and Comprehend in order to Read:

1. They look at the visual symbols (letters) and **Decode** (i.e., convert) them into words.
2. Then, they use their language instinct, linguistic comprehension (vocabulary), and background knowledge, to **Comprehend**—i.e., give meaning—to these **words**. Each person's vocabulary and background knowledge will shape how they **Comprehend** these words. Words like Creator, Rights, and Happiness, are deep words that have layers of meaning, depending on one's background and knowledge of human psychology, history, and politics.

If both Decoding and Comprehension play such a crucial role in Reading, surely they are both desirable. But is there a difference in how they are attained?

Language is a human instinct that has been around since the origin of our species (Pinker, 1994). Reading and Writing is a technology that humans invented a mere 5,500 years ago. Children learn to walk and talk on their own because it is in their nature. It is not in the nature of children to read and write, certainly not to read and write English, a language that was invented over the past 1000 years and is an amalgamation of 5 languages and spelling codes (Anglo-Saxon, Danish, Norman-French, Latin, and Greek).

Humans are born without words but begin to gather a prolific vocabulary without any formal language instruction. It has worked well for tens of thousands of years. There are no "Speaking Classes" or "Speaking Schools" because it is assumed that children will pick up the language from their family and peers. "Comprehension" happens by itself, without formal instruction.

But no child—no matter how intelligent or resourceful—ever "discovered" how to read and write English on their own without some direct instruction. Even the most precocious of children could not unravel the mysteries of the English spelling code, even if they were surrounded by books and immersed in print from birth. The written word is a human invention, and inventions are best learned through direct instruction. Schools were invented for the sole purpose of teaching children to read and write.

Decoding and Comprehension are not learned the same way, and they should not be taught the same way. Comprehension is learned naturally and constantly, whereas Decoding can only be learned through some type of formal instruction.

(To be sure, a child's vocabulary can be increased through direct vocabulary instruction, see Direct Vocabulary Instruction In Preschool, A Comparison of Extended Instruction, Embedded Instruction, and Incidental Exposure, Susan M. Loftus-Rattan, Alison M. Mitchell, Michael D. Coyne (2016). But direct vocabulary instruction is painstaking and slow and does not match children's remarkable ability to learn new words without instruction. See Pinker, 1994.)

We conclude the following: Decoding—which is separate from Comprehension—is integral to Reading. And because Decoding is not part of the naturally developing language instinct—Decoding must be taught.

A question remains: Is there a superior approach of teaching Decoding?

Part 2: Research that Explains How Decoding Should Be Taught

National Reading Panel Report (2000)

"In 1997, Congress asked the NICHD Director, in consultation with the Secretary of Education, to convene a national panel to assess the effectiveness of different approaches used to teach children to read. The Panel was made up of 14 people, including leading scientists in reading research, representatives of colleges of education, teachers, educational administrators, and parents." (www.nichd.nih.gov/)

The National Reading Panel Report (NRP) is long but written in a clear and accessible manner. The NRP reports that Phonemic Awareness (PA) training is effective in teaching children to read. The NRP defines PA as follows:

> Phonemic awareness refers to the ability to focus on and manipulate phonemes in spoken words. The following tasks are commonly used to assess children's PA or to improve their PA through instruction and practice: 1. Phoneme isolation, which requires recognizing individual sounds in words, for example, "Tell me the first sound in paste." (/p/) 2. Phoneme identity, which requires recognizing the common sound in different words. For example, "Tell me the sound that is the same in bike, boy, and bell." (/b/) 3. Phoneme categorization, which requires recognizing the word with the odd sound in a sequence of three or four words, for example, "Which word does not belong? bus, bun, rug." (rug) 4. Phoneme blending, which requires listening to a sequence of separately spoken sounds and combining them to form a recognizable word. For example, "What word is /s/ /k/ /u/ /l/?" (school) 5. Phoneme segmentation, which requires breaking a word into its sounds by tapping out or counting the sounds or by pronouncing and positioning a marker for each sound. For example, "How many phonemes are there in ship? " (three: /š/ /I/ /p/) 6. Phoneme deletion, which requires recognizing what word remains when a specified phoneme is removed. For example, "What is smile without the /s/?" (mile)." (NRP 2-1, 2-2)

However, PA was more effective under certain circumstances. For example:

> Instruction that taught phoneme manipulation with letters helped normally developing readers and at-risk readers acquire PA better than PA instruction without letters. (NRP 2-4)

Later, the NRP spells out the implication for reading instruction:

> Teaching with letters is important because this helps children apply their PA skills to reading and writing. Teaching children to blend phonemes with letters helps them decode. Teaching children phonemic segmentation with letters helps them spell... Teachers should recognize that acquiring phonemic awareness is a means rather than an end. PA is not acquired for its own sake but rather for its value in helping learners understand and use the alphabetic system to read and write. This is why it is important to include letters when teaching children to manipulate phonemes and why it is important to teach children explicitly how to apply PA skills in reading and writing tasks. (NRP 2-6)

The NRP reported its finding concerning the optimal age for PA instruction:

> Although all levels of readers acquired PA successfully, effect sizes were greater for children who were beginning readers at risk for reading failure and normally progressing readers than for older disabled readers. Students in the lower grades, preschool, and kindergarten, showed larger effect sizes in acquiring PA than children in 1st grade and above. (NRP 2-4)

Again, the NRP spells out the implication for reading instruction:

> Early PA instruction cannot guarantee later literacy success. The most reasonable conclusion from the findings of the NRP analysis is that adding well-designed PA instruction to a beginning reading program or a remedial reading program is very likely to yield significant dividends in the acquisition of reading and writing skills. Whether the benefits are lasting will likely depend on the comprehensiveness and effectiveness of the entire literacy program that is taught. Additional factors that play a significant role in children's literacy acquisition are detailed in other sections of the NRP report. (NRP 2-7)

In short: (1) PA is more effective when it is taught using letters, and (2) PA is most effective when taught at an early age. The NRP also reports that phonics instruction is effective in teaching children to read. The NRP defines phonics instruction as follows:

> Phonics Instruction…entails teaching students how to use grapheme-phoneme (i.e. spelling-sound) correspondences to decode or spell words. (NRP 2-2)

These same points made regarding PA are mirrored by the NRP's report in Part II on Phonics Instruction:

> Findings provided solid support for the conclusion that systematic phonics instruction makes a bigger contribution to children's growth in reading than alternative programs providing unsystematic or no phonics instruction. (NRP 2-92)

> Students taught phonics systematically outperformed students who were taught a variety of nonsystematic or non-phonics programs, including basal programs, whole language approaches, and whole-word programs. (NRP 2-95)

The NRP offers a basic definition for these non-phonics programs:

> Beginning reading programs that do not teach phonics explicitly and systematically may be of several types. In whole-language programs, the emphasis is upon meaning-based reading and writing activities. Phonics Instruction is integrated into these activities but taught incidentally as teachers decide it is needed. Basal programs consist of a teacher's manual and a complete set of books and materials that guide the teaching of beginning reading. Some basal programs focus on whole-word or meaning-based activities with limited attention to letter-sound constituents of words and little or no instruction in how to blend letters to pronounce words. In sight word programs, children begin by building a reading vocabulary of 50 to 100 words, and then later they learn about the alphabetic system. These types of non-phonics programs were among those taught to children in the control groups of experiments examined by the NRP. Distinctions among the various types of non-phonics programs are not absolute. However, their defining characteristic is that they do not provide explicit, systematic phonics instruction. (NRP 2-90)

The NRP found that teaching children to read using phonics instruction was the most effective approach of teaching children to read. And the earlier, the better:

> Phonics Instruction taught early proved much more effective than phonics instruction introduced after first grade. Mean effect sizes were kindergarten d = 0.56; first grade d = 0.54; 2nd through 6th grades d = 0.27. The conclusion drawn is that phonics instruction produces the biggest impact on growth in reading when it begins in kindergarten or 1st grade before children have learned to read independently. These results indicate clearly that systematic phonics instruction in kindergarten and 1st grade is highly beneficial and that children at these developmental levels are quite capable of learning phonemic and phonics concepts. To be effective, systematic phonics instruction introduced in kindergarten must be appropriately designed for learners and must begin with foundational knowledge involving letters and phonemic awareness. (NRP 2-93)

Over and over, the NRP stresses the superiority of phonics programs over other approaches:

> Over the years educators have disagreed about how beginning reading should be taught. Some have advocated starting with a systematic phonics approach while others have argued for a whole word approach or a whole language approach. Disagreement has centered on whether teaching should begin with systematic explicit instruction in symbol-sound correspondences, whether it should begin with whole words, or whether initial instruction should be meaning-centered with correspondences taught incidentally in context as

> needed. Most recently the pendulum has swung toward providing children with more explicit phonics instruction. Educators advocating this shift have claimed that there is substantial research showing that approaches with an emphasis on phonics instruction are more effective than approaches that do not emphasize the teaching of phonics. The purpose of this report was to examine the research evidence concerning phonics instruction. (NRP 2-100)

In regards to comprehension, the NRP reports:

> The conclusion drawn is that growth in word-reading skills is strongly enhanced by systematic phonics instruction when compared to non-phonics instruction for kindergartners and 1st graders as well as for older struggling readers. Growth in reading comprehension is also boosted by systematic phonics instruction for younger students and reading disabled students. These findings should dispel the any [sic] belief that teaching phonics systematically to young children interferes with their ability to read and comprehend text. Quite the opposite is the case. Whether growth in reading comprehension is produced generally in students above 1st grade is less clear. (NRP 2-94)

But not all phonics programs are alike. The NRP explains:

> In teaching phonics explicitly and systematically, several different instructional approaches have been used. These include synthetic phonics, analytic phonics, embedded phonics, analogy phonics, onset-rime phonics, and phonics through spelling. Although all explicit, systematic phonics approaches use a planned, sequential introduction of a set of phonic elements along with teaching and practice of those elements, they differ across a number of other features. For example, the content covered ranges from a limited to an elaborate set of letter-sound correspondences and phonics generalizations. In addition, the application procedures taught to children vary. Synthetic phonics programs teach children to convert letters into sounds or phonemes and then blend the sounds to form recognizable words. Analytic phonics avoids having children pronounce sounds in isolation to figure out words. Rather children are taught to analyze letter-sound relations once the word is identified. Phonics through-spelling programs teach children to transform sounds into letters to write words. Phonics in context approaches teach children to use sound-letter correspondences along with context cues to identify unfamiliar words they encounter in text. Analogy phonics programs teach children to use parts of written words they already know to identify new words. (NRP 2-89)

The NRP raises the following question:

> Are some types of phonics instruction more effective than others? Are some specific phonics programs more effective than others? (NRP 2-93)

The NRP's answer is that they found no real difference:

> Three types of phonics programs were compared in the analysis: (1) synthetic phonics programs which emphasized teaching students to convert letters

> (graphemes) into sounds (phonemes) and then to blend the sounds to form recognizable words; (2) larger-unit phonics programs which emphasized the analysis and blending of larger subparts of words (i.e., onsets, rimes, phonograms, spelling patterns) as well as phonemes; (3) miscellaneous phonics programs that taught phonics systematically but did this in other ways not covered by the synthetic or larger-unit categories or were unclear about the nature of the approach. The analysis showed that effect sizes for the three categories of programs were all significantly greater than zero and did not differ statistically from each other. The effect size for synthetic programs was d = 0.45, for larger-unit programs, d = 0.34, and for miscellaneous programs, d = 0.27...The conclusion drawn is that specific systematic phonics programs are all significantly more effective than non-phonics programs; however, they do not appear to differ significantly from each other in their effectiveness although more evidence is needed to verify the reliability of effect sizes for each program. (NRP 2-93)

Why are phonics programs more effective than non-phonics programs such as whole-language programs, basal programs, and whole-word programs?

> "The structure of the English writing system is alphabetic." (NRP 2-2)

It follows that phonics instruction would be effective:

> The goal in all phonics programs is to enable learners to acquire sufficient knowledge and use of the alphabetic code so that they can make normal progress in learning to read and comprehend written language. (NRP 2-89)

Phonics instruction is thus an effective way of teaching decoding:

> Systematic phonics instruction was most effective in improving children's ability to decode regularly spelled words (d = 0.67) and pseudowords (d = 0.60). This was expected because the central focus of systematic phonics programs is upon teaching children to apply the alphabetic system to read novel words. (NRP 2-94)

But the authors of the Report understood that systematic phonics instruction…

> …includes not only the major correspondences between consonant letters and sounds but also short and long vowel letters and sounds, and vowel and consonant digraphs (e.g., oi, ea, ou, sh, ch, th). Also, it may include blends of letter-sounds that recur as subunits in many words, such as initial blends (e.g., st, sm, bl, pr), and final stems (e.g., -ack, -end, -ill, -op). (NRP 2-99)

In summary, Phonics instruction works because English is an alphabetic code and:

> Learning about letter-sound associations helps beginners break the code in learning to read. (NRP 2-100)

But the NRP stresses that there is more to reading than phonics:

> However, the English writing system has other higher level, word-based regularities as well, so, although phonics instruction contributes, it is not the

> complete solution to word identification that it is in other written languages that are more fully phonemic (e.g., Spanish). (NRP 2-100)

The indispensable role decoding plays in the reading process is made clear in research done on groups of students, some of which were taught to read using phonics, and some of which were taught to read using a Whole-Word approach. Although the students that were taught to read using the Whole-Word approach also learned to read, the researchers found that they *also learned to decode*. In fact, it became difficult to know which children were taught by which approach. Still, the children who were taught using phonics were better readers than those who were taught using Whole-Word approaches (Barr, 1970; Biemiller, 1971).

In other words: all reading is accomplished through decoding, and the most effective approach to teaching "decoding" is phonics. Children who are taught to read using Whole-Word approaches are forced to teach themselves how to "decode." The NRP argues that it is better to teach children how to decode directly, and not ask them to figure it out on their own, a task that takes time, and that some might never accomplish.

The NRP is a treasure trove for teachers as well as curriculum developers. Their discussion regarding mnemonics should be of great interest to all teachers:

> The value of mnemonics for teaching letter-sound relations to kindergartners is supported by evidence. In a study by Ehri, Deffner, and Wilce (1984), children were shown letters drawn to assume the shape of a familiar object, for example, s drawn as a snake, h drawn as a house (with a chimney). Memory for the letter-sound relations was mediated by the name of the object. Children were taught to look at the letter, be reminded of the object, say its name, and isolate the first sound of the name to identify the sound (i.e., s snake -/s/). With practice they were able to look at the letters and promptly say their sounds. Children who were taught letters in this way learned them better than children who were taught letters by rehearsing the relations with pictures unrelated to the letter shapes (e.g., house drawn with a flat roof and no chimney) and also better than children who simply rehearsed the associations without any pictures.
>
> Application of this principle can be found in Letterland (Wendon, 1992), a program that teaches kindergartners letter-sound associations. In this program, all the letters are animate characters that assume the shape of the letters and have names prompting the relevant sound, for example, Sammy Snake, Hairy Hat Man, Fireman Fred, Annie Apple. The task of learning the shapes and sounds of all the alphabet letters is difficult and time-consuming, particularly for children who come to school knowing none. The relations are arbitrary and meaningless. Techniques to speed up the learning process are valuable in helping kindergartners prepare for formal reading instruction.
>
> The motivational value of associating letters with interesting characters or hand motions and incorporating this into activities and games that are fun is important for promoting young children's learning. If the task of teaching letters is stripped bare to one of memorizing letter shapes and sounds,

> children will become bored and easily distracted and will take much longer to learn the associations. (NRP 2-125)

The NRP has done a great service in laying to rest the great debate regarding Phonics vs. other approaches to teaching children to read (Whole-Language, Whole-Word, etc.). Thanks to the NRP, Phonics is now part of most children's reading curriculum, and the Big 5 is more than a sporting good store, but a mnemonic for 1. Phonemic Awareness; 2. Phonics; 3. Vocabulary; 4. Fluency; and 5. Comprehension. (The NRP's assessment of Fluency and Comprehension are outside the scope of this paper.)

Two things must be pointed out:

1. The NRP did not favor any specific type of phonics instruction. The Panel studied three types: "Three types of phonics programs were compared in the analysis: (1) synthetic phonics programs which emphasized teaching students to convert letters (graphemes) into sounds (phonemes) and then to blend the sounds to form recognizable words; (2) larger-unit phonics programs which emphasized the analysis and blending of larger subparts of words (i.e., onsets, rimes, phonograms, spelling patterns) as well as phonemes; (3) miscellaneous phonics programs that taught phonics systematically but did this in other ways not covered by the synthetic or larger-unit categories or were unclear about the nature of the approach." (NRP 2-93) The NRP took no sides.
2. The NRP stresses that phonics on its own does not work, because "the English writing system has other higher level, word-based regularities as well, so, although phonics instruction contributes, it is not the complete solution to word identification that it is in other written languages that are more fully phonemic (e.g., Spanish). (NRP 2-100)

A close inspection of current reading programs—especially those claiming to be "evidence-based" and in keeping with the recommendations of the NRP—reveals common threads. Indeed, they all include some or all of the following strategies:

1. Students are taught to name the letters of the alphabet, usually by singing the Alphabet Song;
2. Students are taught to listen to and produce rhymes;
3. Students are taught to orally manipulate parts of speech such as syllables;
4. Students are taught to orally manipulate parts of speech such as onsets and rimes;
5. Students are taught to orally manipulate parts of speech such as phonemes;
6. Students are taught the sounds of the letters;
7. Students are taught to differentiate between vowels and consonants, and that some are short and some are long;
8. Students are taught to memorize high-frequency words (i.e. sight-words) (e.g., I, you, we, are, does)
9. Students are taught to word families such as: take, bake; bike, like, etc.
10. As the NRP points out, some phonics programs "may include blends of letter-sounds that recur as subunits in many words, such as initial blends (e.g., st, sm, bl, pr), and final stems

(e.g., -ack, -end, -ill, -op)." (NRP 2-99). These "consonant clusters" and "rimes" are taught as a new unit, and students memorize them as such.

11. Students are taught spelling rules, and their many exceptions.

It should not surprise that reading programs try to cover all the basis by doing a little bit of everything. Students are therefore taught to read in "multiple strategies." They get some Phonemic Awareness, some Synthetic Phonics, some Analytic Phonics, even some Sight-Words.

Many of these "strategies" made their way into the **Common Core State Standards, Reading Standards for Foundational Skills (RF)**. In Kindergarten, children are expected to demonstrate competence in the following areas:

1. Recognize and name all upper- and lowercase letters of the alphabet. (RF.K.1.4)
2. Recognize and produce rhyming words. (RF.K.2.1)
3. Count, pronounce, blend, and segment syllables in spoken words. (RF.K.2.2)
4. Blend and segment onsets and rimes of single-syllable spoken words. (RF.K.2.3)
5. Isolate and pronounce the initial, medial vowel, and final sounds (phonemes) in three-phoneme (consonant-vowel-consonant, or CVC) words. Add or substitute individual sounds (phonemes) in simple, one-syllable words to make new words. (RF.K.2.4 & RF.K.2.5)
6. Demonstrate basic knowledge of one-to-one letter-sound correspondences by producing the primary sound or many of the most frequent sounds for each consonant. (RF.K.3.1)
7. Associate the long and short sounds with common spellings (graphemes) for the five major vowels. (RF.K.3.2)
8. Read common high-frequency words by sight (e.g., the, of, to, you, she, my, is, are, do, does). (RF.K.3.3)

Just as Whole-Language and Whole-Word approaches were ready to surrender to Phonics, a new approach swooped in: A "Multiple Strategy" approach to reading instruction.

But how do children implement Multiple Strategies when encountering text? How do they decide which strategy to implement? Should they try to read the words by sight, or should they decode them? Should they use word-analogy, or instead break the words down into syllables to look for short-vowels and long-vowels? Or perhaps they should analyze each word using a spelling rule, and then be on the lookout for exceptions to those same rules?

The confusion caused by Multiple Strategies might be worthwhile if the strategies would all be useful and backed by research.

But are they?

A meta-analysis has shown that Phonemic Awareness—i.e., knowledge of individual phonemes, as opposed to "rime awareness"—shows the strongest correlation with individual differences in children's word reading skills (Phonological skills and their role in learning to read: a meta-analytic review, Melby-Lervåg M, Lyster SA, Hulme C., 2012.).

A recent study of "syllable awareness" showed that not only did phonological awareness on the level of the syllable not aid the students' reading ability, it made it harder for them to acquire

phonological awareness on the level of the "phoneme" (The effects of syllable instruction on phonemic awareness in preschoolers, Teresa A. Ukrainetz, Janae J. Nuspl, Kimberly Wilkerson, Sarah Rose Beddes, 2015).

All this makes sense. Phonemes are the smallest phonological units of speech, onsets and rimes are larger, and syllables are the largest. Words are sometimes phonemes (a, I, oh), sometimes onsets (ate, it), sometimes a single syllable (ate, it), and sometimes more (vindicate, composite).

A comprehensive list of phonological units of speech bigger than the phoneme include the following:

1. Onset (the beginning consonants of a word: **tr**-ap)
2. Rime (the vowel and following consonants of a word: tr-**ap**)
1. Syllable (the largest phonological units of speech within a word: **rab-bit**)
2. Word (an entire word as a whole: **the, you, we**)

English is an Alphabet which encodes phonemes by writing down letters. It should not surprise that teaching students to listen to anything but the phoneme would distract students' attention away from the phoneme.

Reading words by decoding large units within the word is a type of phonics instruction known as "analogy." Students break the word into onsets and rimes, decode them, and read the word. Onsets are the beginning consonants, and rimes are the vowel and following consonants (e.g., cl-amp, str-eet). Students are taught to use onsets and rimes in known keywords to read unknown words (i.e., use the known word "drink" to read "dream," or "bake" to read "make"). The process of reading words by analogy has been studied extensively.

However, research has shown that beginning readers are better off with phonics instruction that begins with the "smaller unit," i.e., the phoneme, than the larger onset-rime unit. For example, Ehri and Robbins (1992) showed that beginning readers needed to master the sound-to-spelling associations before they showed any ability to transfer their knowledge of known words to read new words sharing rimes. Bruck and Treiman (1992) found that beginning readers were more successful analogizing known to new words when they relied on sound-to-spelling associations rather than on onsets and rimes. See also Nation and Hulme (1997).

So much for comparing programs that employ either the sound-to-spelling unit (phoneme) or the onset and rime unit. But what happens when researchers compare programs that employ the onset and rime unit with another program that employs the onset and rime unit *plus* the sound-to-spelling unit?

A 4 year study investigated the effect of two types of reading programs (Linnea C. Ehri, Eric Satlow & Irene Gaskins, 2009). In the first, reading is taught by teaching students to decode large units within words (onsets and rimes), as explained above. Students are then taught to use onsets and rimes in known keywords to read unknown words (i.e., use the known word "drink" to read "dream," or "bake" to read "make"). In the second, reading instruction included additional training in sound-to-spelling analysis, i.e., students were also taught to decode sound-to-spelling patterns smaller than the onset and rime unit, i.e., on the level of the phoneme. This study was intended to determine whether the addition of a sound-to-spelling foundation would improve the effectiveness of the onset and rime approach.

The students who were taught to analyze sound-to-spelling relations in keywords did develop significantly better word decoding and spelling skills than students who were taught to analyze onset and rime units in keywords. The evidence thus indicates that beginning readers should master sound-to-spelling associations on the level of the phoneme before they learn onsets and rimes.

The "long vowel" and "short vowel" markers which are ubiquitous in American classrooms are long overdue for a rebranding. Linguists (and sound engineers) agree that long vowels are not necessarily long, and short vowels are not necessarily short (The American Way of Spelling: The Structure and Origins of American English Orthography, Richard L. Venezky, 1999, p. 62-63).

The research indicates that PA instruction is more effective when taught with the use of letters (NRP 2-4). Strategies that teach students to manipulate phonemes (and other parts of speech) orally are not as effective, yet are still common practice and even included in the CCSS.

It is now common practice to teach young students to memorize a number of important high-frequency words or sight-words. A short list includes: I, a, you, are, we, were, of, was, that, etc. The term "high-frequency" requires no explanation, but the term "sight-words" does. Sight-Words are thought to be words that cannot be decoded and therefore must be memorized by "sight," hence the term "Sight-Words." It is the same logic underlying the "Look and Say" and Whole-Word approaches.

But researchers have shown how difficult it is to memorize a string of non-alphabetic symbols (Ehri & Wilce, 1987; Jorm, 1981). Divorced from their phonemic pronunciations, letters are not much more than a random arrangement of symbols. Having students memorize Sight-Words in which no association between phonemes and spelling is established offers no opportunity for the student to link sounds to spelling patterns—because words such as "you, are, is, the" are presented as random collections of isolated symbols that must be memorized without rhyme or reason. These Sight-Words are either forgotten or become a load on the child's memory. (The issue of irregularly spelled words and how we teach them will be dealt with below.)

As the structure of the English writing system is alphabetic, decoding is most efficiently and successfully taught using phonics instruction. The NRP has thus put the Great Debate behind us, with Whole-Word and Whole-Language approaches a thing of the past, and phonemic awareness (PA) and phonics instruction an integral part of many reading curricula. But the NRP's indecision among the various types of phonics approaches, together with their insistence that phonics "is not the complete solution" (NRP 2-100) has left the door open to a new approach, one we refer to as a "Multiple Strategy" approach. Many of these strategies are not based on the latest research. Furthermore, the sheer number of strategies used to teach children to read can confuse the child in choosing which strategy to implement.

We conclude the following: A new phonics program should be devised, one that is based solely on the phonological unit that matters in English: the phoneme. For this new phonics program to be effective it should not employ "Multiple Strategies."

A question remains: Can a new research-based phonics program be created?

Part 3: A New Evidence-Based Approach

Diane McGuinness, Early Reading Instruction: What Science Really Tells Us about How to Teach Reading, MIT Press (Cambridge, MA), 2004

Diane McGuinness, Language Development and Learning to Read: The Scientific Study of How Language Development Affects Reading Skill, MIT Press (Cambridge, MA), 2005

Diane McGuinness analyzed the reading research and contended that the process of "Decoding" can be easily explained by asking a simple question: How did the words get on the page in the first place? The written word is not an artifact, like a rock, or a tree. It is a man-made invention. If we understand how words made their way from our minds to the page (a process called Encoding), then we can easily explain how words make their way off the page and into our minds (a process called Decoding).

McGuinness refers to this system as a Reversible Code, but we prefer the term algorithm. An algorithm is a set of preconfigured associations or rules (if this then that) for either solving a complex problem or achieving a complex goal in a finite number of steps. While the final product might seem complex, each small step within the algorithm is simple and requires little thought (e.g., cheesecake recipe, Rubik's Cube). An algorithm for reading is a set of preconfigured associations between Sounds and Spelling Patterns. These small steps—when followed with fidelity—achieve a complex goal: Decoding. (When Comprehension is applied, the net result is: Reading.) While the final product might seem complex, each small step within the algorithm is simple and requires little thought.

McGuinness is not alone. This idea is echoed by Share:

> Because *all* words are novel at some point in reading development, the reader must possess some algorithm, albeit imperfect, yet nonetheless functional for *independently* identifying words encountered for the first time in everyday reading…An effective orthography must first provide the reader with a means for deciphering new words *independently*. This applies to both the young child new to the world of print, and to the skilled reader encountering a new or unfamiliar word. Furthermore—and this is crucial to skill learning in all domains—this algorithmic process must lay the foundations for the rapid direct-retrieval mechanism. This do-it-yourself" or "self-teaching" function of decoding is probably the chief virtue of alphabetic scripts—supplying not only an economical means for identifying new words (via print-to-sound translation), but critically, establishing the detailed orthographic representations on which rapid fully unitized skilled word recognition is founded. (Share, 2008, Orthographic Learning, Phonology and the Self-Teaching Hypothesis. p. 38-39)

According to Share this algorithm as "imperfect" as the reader is constantly undergoing developmental changes as they decipher and learn new words, a concept Share refers to as Lexicalization (Share, 2008, Orthographic Learning, Phonology and the Self-Teaching Hypothesis. p. 41).

McGuinness boldly claimed that all previous English curricula were flawed. Whole-Language curricula failed because they did not teach **how to decode**. But Phonics curricula failed because they did not teach **the entire code**. A true phonics program must teach the entire algorithm, meaning: every sound-to-spelling association that exists in that writing system. If Decoding is a skill that is accomplished by learning how to implement an algorithm then a **Comprehensive** Algorithm is like a complete set of tools.

McGuinness stressed that all reading instruction must be based on the nature of the language being taught. Since English is an alphabetic language which is based on the phoneme, it follows that only the phoneme should be taught.

She deduces that teaching students to read by having them listen to syllables will only distract them from listening to the only unit of speech they need to be "aware" of: the phoneme. Research has backed up this assertion. (The effects of syllable instruction on phonemic awareness in preschoolers, Teresa A. Ukrainetz, Janae J. Nuspl, Kimberly Wilkerson, Sarah Rose Beddes, 2015). She applied the same logic to the teaching of onsets and rimes. Recent research has confirmed this is well (Phonological skills and their role in learning to read: a meta-analytic review, Melby-Lervåg M, Lyster SA, Hulme C., 2012.).

McGuinness observed that because the phoneme is paramount than teaching children the names of the letters *during* reading instruction is not a priority, and may be a distraction.

Lastly, McGuinness warned that having students memorize sight-words encourages them to not rely on a decoding strategy—the logical foundation of phonics. This is the opposite of what we want to encourage.

McGuinness set out to write her "algorithm." She listed the phonemes in the English language (there are about 40) and then listed the Spelling Alternatives for each phoneme. Some sounds have only one spelling, and some as many as ten. It is a grand project, and because pronunciations constantly change, it is a never ending project.

As McGuinness saw it, every word in English—from "rat" to "aristocrat"—is decodable. There are no Sight-Words in English, and no words are read "by sight." This means that no words are "stored whole" in our memory. Instead, our brain decodes every word we see using the "algorithm." Our brain is so efficient at decoding that we are no longer aware it is happening.

Again McGuinness is not alone. Other researchers have argued that all words begin as "unfamiliar" and transition to "familiar," and that all readers begin as "novices" and transition to "experts" (Share, 2008, Orthographic Learning, Phonology and the Self-Teaching Hypothesis. p. 38-39).

The NRP laments that phonics is not a complete solution because English is not like other languages such as Spanish. Spanish is a transparent code, and English is an opaque code. But McGuinness's "algorithm," with its one-to-one correspondence between every sound and every spelling pattern in English makes reading English no different than reading Spanish: both languages are decodable.

If today's curricula use "Multiple Strategies," then **CAPIT Reading** is the first and only **Singular Strategy** approach to reading instruction.

In CAPIT Reading Level 1 students are taught the phonemes associated with each letter of the alphabet, both lowercase, and uppercase. Only the phonemes are taught during reading instruction—not the names of the letters—because only Phonemic Awareness is necessary for decoding an alphabet. (Letter names are not taught as it is assumed students already learned them or will learn them from the teacher.)

Phonemes are taught using a Single Strategy: Students hear a sound and learn to spell the sound.

CAPIT Reading never teaches students to manipulate phonemes orally. CAPIT Reading always utilizes letters to teach phonemic awareness. This is based on the research that phonemic awareness exercises that utilize letters are more effective than those that do not. In the words of the National Reading Panel Report: "Instruction that taught phoneme manipulation with letters helped normally developing readers and at-risk readers acquire PA better than PA instruction without letters." (NRP, 2000, 2-4. See also 2-6.)

To help Establish sound-to-spelling associations CAPIT Reading provides a "visual mnemonic" for every letter of the English alphabet, both lowercase, and uppercase (ee below for two of our mnemonics).

These visual mnemonics help establish an objective association in the student's mind between the Sound and Spelling, unburdening the student's memory, and easing the learning process. A Visual Mnemonic is like "cognitive super glue," magically and quickly pairing together "Sounds" and "Spellings" to one another with a lasting bond. The NRP (2-125) extols the virtue of visual mnemonics which it believes helps children with the difficult task of memorizing "arbitrary and meaningless" relations between "shapes and sounds." (For a fuller discussion on how we chose our mnemonics CLICK HERE.)

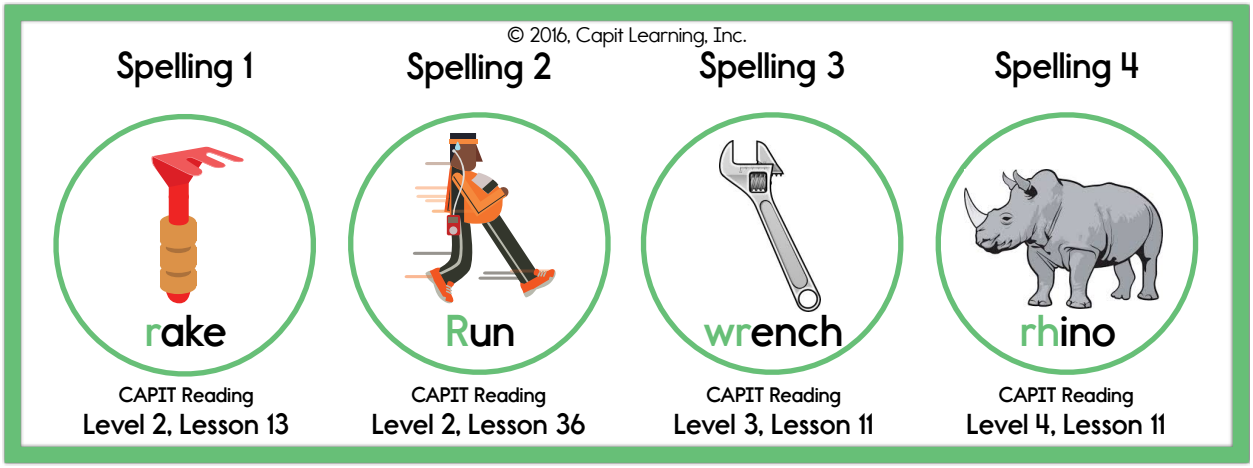
Once students learn the phonemes associated with the lowercase and uppercase letters, they are taught to blend them into VC (Vowel Consonant) and CVC words. Students immediately begin reading books they can read based on the (simple) words and sentences they can decode.

When students master CVC words they progress to Consonant Clusters of all types (e.g., ant, milk, clock, stamp). Students then begin decoding multi-syllable words (e.g., rabbit, picnic).

All this is done using the same strategy: students decode words by applying the algorithm to decode new words one spelling and one sound at a time.

Students are then introduced to additional sound and spelling patterns. As each new digraph or diphthong is introduced students are taught to decode new words and sentences. Again, the strategy is the same: students decode words by applying the algorithm to decode new words one spelling and one sound at a time.

CAPIT Reading helps students understand the algorithm by categorizing "Spelling Patterns" clearly. We provide an example below: the Sound /r/ can be spelled in four different ways: "**r**" as in **r**ake, "**R**" as in **R**un, "**wr**" as in **wr**ench, and "**rh**" as in **rh**ino:



Some sounds have a single spelling pattern, such as /th/ as in bath and /ar/ as in car. But some have as many as ten (the sound /ee/). Few languages have many "Spelling Patterns" for their sounds of speech, and no language has as many spelling patterns as English. This is a product of unique historical developments which led to an amalgamation of five separate languages and spelling codes. This also explains why English is the most difficult writing system to master, and why so many think it is "undecodable."

A comprehensive and complete phonics program would, by necessity, teach every Sound in English, and then teach how these Sounds are spelled without omitting a single spelling. In our estimation there are 46 Sounds in the English language (we include /air/ and /ul/ as unique phonemes because of their unique spelling patterns). These 46 Sounds can be spelled in about 181 Spelling Patterns. CAPIT Reading teaches students each and every Sound and Spelling one lesson at a time. The CAPIT Reading curriculum is a **Comprehensive Algorithmic Approach** to reading instruction because our algorithm teaches the English alphabet code in its entirety. Each portion of the algorithm is introduced one per lesson, so students never have to learn more than one new concept at a time. In each lesson students are tasked with reading and spelling novel words that contain the new spelling. Sufficient exposure to novel words is important for skilled reading. According to the "self-teaching" hypothesis proposed by Jorm and Share (Jorm & Share, 1983; Share, 1995), "phonological recoding (print-to-sound translation) performs a self-teaching function enabling the learner to acquire the detailed orthographic

representations necessary for fast, efficient visual word recognition" (Share, 1999). Share elaborates:

> The self-teaching hypothesis (Firth, 1972; Jorm, 1979; Jorm & Share, 1983; Share, 1995) proposes that the ability to translate unfamiliar printed words into their spoken equivalents ("phonological recording" or simply "decoding") is the central means by which orthographic representations are acquired. Each successful decoding of a new word is assumed to provide an opportunity to acquire the word-specific orthographic information that is the foundation of skilled visual word recognition. Exhaustive phonological recording is assumed to be critical for the formation of well-specified orthographic representations because it draws the reader's attention to the graphemic detail—the order and identity of the letters and how they map onto the phonological representation—the spoken form (see Ehri, 1992, 2005l Perfetti, 1992). In this way, phonological recording functions as a self-teaching or built-in teacher enabling a child to independently develop the word-specific orthographic knowledge necessary for skilled reading.
>
> The self-teaching idea is a little unconventional in that the process of orthographic learning is assumed to take place unintentionally, as a byproduct of the process of decoding—readers do not usually aim to analyze and remember spellings, it just happens and probably without our being aware of the process. It is important to note too that the self-teaching idea rejects the intuitively appealing notion that identities of most new printed words can be directly taught (by teachers, parents, or peers) or can be guessed on the basis of contextual information (see Share, 1995 for detailed discussion). Only decoding seems to offer a sufficiently reliable means for identifying novel letter strings (owing to the fundamentally alphabetic nature of the written code) thereby providing the opportunities for (incidental) learning of the visual form (spelling) of these items). (Share, 2008, Orthographic Learning, Phonology and the Self-Teaching Hypothesis. p. 35-36)

In CAPIT Reading students are exposed to the entire alphabet code and through it they are taught to decode countless words enabling students to develop the "word-specific orthographic knowledge necessary for skilled reading."

Because the CAPIT Reading algorithm teaches the entire alphabet code—all 46 Sounds and 180 Spelling Patterns—no other strategies are necessary to produce successful readers. Our **Single Strategy** approach to reading instruction enables students to decode without confusion.

Instead of teaching students to memorize high-frequency words by sight, CAPIT Reading teaches students how to decode them. Each high-frequency word is taught only after the student has learned the part of the code necessary to master that word. For example, the word "the" will be taught only after the student has learned the digraph /th/; the word "are" will be taught only after the student has learned the diphthong /ar/; the words "to, do, and you" utilize an alternative spelling for the sound /oo/, that is taught after students learn the normative spelling "oo" (e.g., moon, soon). CAPIT Reading encourages students to approach every word in English as a word to decode.

A student of CAPIT Reading is aware that "learning to read" and "learning to spell" are not distinct tasks, but two sides of the same coin. This point is driven repeatedly. Every lesson introduces a new Sound and Spelling Pattern which enables the student to decode new words. The student is then tasked with memorizing and spelling these words. The student thus treats spelling and reading as a singular task. Although "reading" leads to orthographic learning, "spelling" is a more powerful learning tool that leads to more consistent orthographic learning (Shahar-Yames and Share, 2008). Why does spelling of words lead to more consistent orthographic learning outcomes than reading? According to Share spelling makes "additional processing demands" on the students, and "obliges the writer to process each and every letter in a word on every occasion whereas decoding encounters, although likely to be quite exhaustive initially, are probably less exhaustive on subsequent occurrences—particularly in connected text" (Share, 2008, Orthographic Learning, Phonology and the Self-Teaching Hypothesis. p. 71).

Instruction in the CAPIT Reading program is "Guided" (see Conclusion) in the full sense of the word. Students never have to guess what to do next, and never have to guess an answer. Students are never shown information they have not learned. In every interface, the information is presented directly and clearly. In every lesson, the student is expected to learn a single new skill or one new concept.

Conclusion

Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching, Paul A. Kirschner, John Sweller, and Richard E, Clark. Educational Psychologist, 2006.

In their article "Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching," the authors Paul A. Kirschner, John Sweller & Richard E. Clark, present the evidence that Guided Instruction is more effective and more efficient than Unguided Instruction, Minimal Guided Instruction, Constructivist Learning, Discovery Learning, Problem-Based Learning, Experiential Learning, and Inquiry-Based Teaching. The authors present "Evidence for the superiority of guided instruction…in the context of our knowledge of human cognitive architecture, expert–novice differences, and cognitive load" as well as "evidence from empirical studies over the past half-century that consistently indicate that minimally guided instruction is less effective and less efficient than instructional approaches that place a strong emphasis on guidance of the student learning process." Most importantly for our discussion, the authors argue that Minimal Guided Instruction (in all its flavors) "ignores…the structures that constitute human cognitive architecture."

Two aspects of human cognitive architecture are (1) long-term memory and (2) working memory. The goal of all instruction is to create positive change in the student's long-term memory. If nothing has changed, then nothing has been learned. If we can store information in long-term memory we will be able to remember many names, address, phone numbers and countless skills. But for information to get stored in long-term memory, it must first get processed in the cognitive structure where conscious processing occurs—working memory—which has two known limitations:

1. Working memory forgets new information within 30 seconds unless the information is rehearsed;
2. Working memory has a small capacity. Seven random digits or numbers strain most individual's working memory.

These limitations apply only to new information. Information stored in long-term memory can be extensive and be recalled over prolonged periods of time.

All forms of Minimal Guidance Instructions, including Discovery Learning, Problem-Based Learning, Experiential Learning, Constructivist Learning and Inquiry-Based Learning, put a cognitive load on working memory. Working memory has two built-in limitations when dealing with new information. Minimal Guidance Instruction adds to the cognitive load of working memory by forcing the student to expend further energy "constructing" and "inquiring."

Guided Instruction presents the material to the students clearly and with minimal cognitive load, allowing their working memory to quickly grasp the concept and store it in long-term memory —a process known as learning.

While the authors of the above study do not address reading directly—but rather learning in general—their paper is quite relevant to teaching children to read English. We have a long history of "Minimal Guided Reading Instruction." Some have argued that children can learn to read the same way they learn to speak, and that reading is a "Linguistic Guessing Game" (Whole-Language). Others took a "balanced" approach (a little phonics, some Sight-Words, a little Whole-Language). Many parents and teachers still swear that some kids "just learn to read on their own."

The evidence shows that Minimal Guided Instruction has failed students in every field they have been tried. Students learn best when experts create good curricula and find the best way of presenting the information to the student. It works for music, chess, and gymnastics, and it works for math and science. It can surely work for reading.

5-year-old children do not need to do the work of the linguist and figure out the English sound-to-spelling associations on their own. Adults can do the heavy lifting for them.

This is what we set out to do. We hope they enjoy our program.