Who's Afraid of the Science of Reading?: Face Your Fears with Top Reading Strategies

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Abstract

While the National Assessment of Educational Progress (NAEP) *Report Card* for Indiana fourth- and eighth-grade public school students in Indiana are rated as *Basic*, for fourth grade the score is lower than it has been since 1992 and eighth grade in 2005. The Indiana state legislature has passed into law a bill requiring the five components of the science of teaching in both the K-6 settings and teacher preparation programs. First, teachers need to understand the Science of Reading and its components. Then teachers can put some strategies to work to help their students excel in reading. This article discusses what the five components are and gives some research-based activities that teachers can use in the regular classroom.

Editors' Note: *This article provides an overview of research-based approaches for teaching reading to elementary age students. It should be understood that no one article can provide comprehensive information on the Science of Reading and that multiple sources should be reviewed to implement research-based instructional approaches within a literacy curriculum.*

Learning to read is a foundational skill required in all aspects of life. Learning to read is not as easy task. In 2023, the Indiana General Assembly passed House Bill 1558 that requires the Science of Reading (SoR) to be implemented across the state. This will affect classroom teachers and teacher preparation programs alike. Educators across the state are now viewing the curriculum through the lens of SoR:

- Is the curriculum aligned with SoR and best practices?
- What are the components of SoR and how can they be taught explicitly and systematically?

While these are good questions to ask, there is no need to be afraid of SoR.

The National Assessment of Educational Progress (NAEP) tests public school students' literacy abilities every two years (NAEP, 2022). Since 1992, Indiana's average fourth grade reading scores have remained at the *Basic* level (cut score of 208 for 2022). The *Basic* level is defined by NAEP as "partial mastery of prerequisite knowledge and skills that are fundamental for performance at the *NAEP Proficient* level" (para. 2). The *NAEP Proficient* level is defined as "represents solid academic performance for each NAEP assessment. Students reaching this level have demonstrated competency over challenging subject matter, including subject-matter knowledge, application of such knowledge to real world situations, and analytical skills appropriate to the subject matter" (para.1). Since 2015, Indiana's scores have been dropping to an all-time low in 2022 to 217. This is above the national average by one point (not statistically significant). This downward trend started before the COVID pandemic and resulting school closures.

Regardless of grade level, teachers should instruct students in all five components of the Science of Reading (SoR). Younger grades start with oral language and phonemic awareness and progress through phonics, vocabulary, fluency, and comprehension. In the regular classroom in

high school, content area teachers use vocabulary, fluency, and comprehension strategies to assist students in reading to learn. Even middle and high school teachers need to know and understand the five components of SoR. The story of the author Patrica Pollacco, as described in the book *Thank You, Mr. Falker,* is an excellent example. All teachers everywhere, regardless of content area or grade level, can be a struggling student's very own Mr. Falker.

But what are the five components of reading? In 2000 the National Reading Panel (NRP) identified the five components as Phonemic Awareness, Phonics, Fluency, Vocabulary, and Comprehension. We will showcase the five components by defining what each component is and sharing research-based strategies that teachers of older students as well as younger students can use in their regular classroom. Remember throughout the discussion that scaffolding is one of the most important techniques for delivering explicit instruction.

Scaffolding builds learning by supporting students with guidance by a teacher or more capable peer. This guidance is then slowly removed as students become more capable. Scaffolding within a students' Zone of Proximal Development (Vygotsky, 1978) allows teachers to instruct students and shift "the responsibility for learning from the teacher to the students" (Honig, Diamond & Gutlohn, 2018, p. 625). Furthermore, teachers can interleave (alternating topics during practice) their guided and independent practice opportunities to boost student memory and transfer of knowledge (Firth, Rivers, & Boyle, 2021; Van Hoof, Sumeracki, & Madan, 2022). Let us start with phonemic awareness.

Phonemic Awareness

Phonemic awareness is defined by the *Reading Sourcebook* as "the ability to detect, identify, and manipulate phonemes in spoken words" (Honig et al., 2018, p. 2). The NRP defines phonemic awareness as "the ability to focus on and manipulate phonemes in spoken words" (p. 2-1). Phonemes are the smallest individual speech sounds (NRP, 2023). There are approximately 44 phonemes (sounds) in the English language. Phonemic Awareness is an essential component of reading because it lays the foundation of phonics instruction. Phoneme skills range from basic phoneme isolation (recognizing that *dog* begins with /d/) to more difficult phoneme substitution (changing the /t/ of *cat* to /p/ to make *cap*). Dr. Tolman explains the levels of phonemic awareness in her hourglass figure (Moats & Tolman, 2019). At the top of the hourglass is phonological awareness (an umbrella term including words, syllables, onset, rime, and phonemes) and the narrowest part of the hourglass is the individual phoneme. Between the top and middle are the early, basic, and advanced levels of phonological awareness and phonemic awareness. You can visit Dr. Tolman's website (https://drcaroltolman.com/introduction-to-the-tolman-hourglass-figure/) to learn more about the hourglass figure.

Most students benefit from just five to ten minutes' worth of focused daily phonemic awareness activities over 12 to 20 weeks. Activities that you can use to help you teach phonemic awareness in systematic explicit manner are 1) Auditory Onset and Rime Activities and 2) Elkonin Boxes.

Auditory Onset and Rime Activities

Part of phonemic awareness is recognizing onset and rime. Onset is the consonant letters at the beginning of a one-syllable word or the first part of a syllable in a multi-syllabic word. An easy example would be the /b/ of *ball* or the /str/ of *string*. Rime is the vowel and following consonants. In the word *ball*, the rime is /all/. In the word *string*, the rime is /ing/. Rime is different from rhyme in that rime refers specifically to the spelling and rhyme refers to how the

word sounds. The words *I* and *eye* rhyme but they do not have the same rime. In the activity called Auditory Onset and Rime, you decide if you are focusing on the onset or the rime for that day's lesson. To complete this activity, provide students with cards of pictures that have the focused onset or rime and a few other cards that do not. The teacher can show a picture, object, or just say the word and the students choose the card(s) that have that same onset or rime. For example, if the onset is /b/, then the teacher might show a picture of a bear and tell the students to find the pictures that starts with /b/ like *bear*. The students would then look through their cards and display (on their desk or holding it up) cards that start with /b/. For example, bird, bunny, ball, etc. If the lesson was on rime, the teacher might show a picture of a cat and tell students to select cards that end with /at/. Students might display *rat*, *fat*, *hat*, *mat,* or *bat*.

Elkonin Boxes

Elkonin boxes or sound boxes was first developed in 1963 by a Russian psychologist named Elkonin (Honig et al., 2018). Elkonin boxes are "a card with a picture and boxes that represent the number of phonemes in the picture name" (p. 156). This activity provides a way for students to visually see the number of phonemes in a word (Manyak, 2008). This lesson can be easily used with one syllable words that have two-, three-, four-, or five-phonemes in them. To conduct this activity, the teacher displays the Elkonin card like one pictured in Figure 1 along with a picture, for example, a *sun*. The teacher points to the picture and asks, *What is this*? (the sun). The teacher models pronouncing the sounds in the word and for each sound moving a paper circle into the box on the paper. The word *sun* has three phonemes: /s/, /u/, /n/. Always remember after segmenting or breaking down the word into its individual phonemes (sounds), to blend it all together again and say the word (*sun*).

Figure 1
Elkonin Boxes Examples
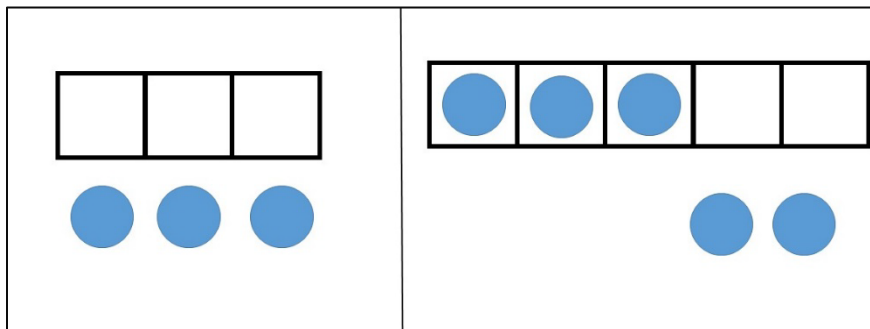
When working with Elkonin Boxes, do not use words with multiple irregularities or unpredictable phoneme-grapheme correspondences. When working with younger students, encourage accuracy by having the Elkonin cards with only the correct number of boxes (*sun* would have three boxes for the three phonemes like the left side of Figure 1). Older students with more accomplished phonemic awareness, can have more boxes than needed for the word (like the right side of Figure 1).

Phonics

Phonics is "instruction in the relationship between letters and the sounds they represent" or between graphemes and phonemes (Honig et al., 2018, p. 170). A grapheme is the written

representation of a phoneme. The grapheme *b* stands for the phoneme /b/, the grapheme *x* stands for the phoneme /ks/, and the grapheme *ch* stands for the phoneme /ch/. Because phonemic awareness deals only with the sounds or phonemes in the English language, another important concept in phonics is the Alphabetic Principle. This is defined as connecting letter shapes with the sounds they make (National Center on Improving Literacy, 2023). In SoR, spelling is incorporated into phonics instruction.

There are many research-based activities that can be used to help teach phonics skills. While many of the individual phonics concepts are grade specific (individual speech sounds, digraphs, blends, schwa, morphemes, affixes, contractions), these activities can be used with multiple concepts across several grade levels. These activities are 1) Sound Walls and 2) Word Ladders.

Sound Walls

Many teachers are familiar with word walls. However, researchers stress using sound walls instead of word walls (Novelli & Sayeski, 2022; Prescott, 2022). Sound walls are constructed similarly to word walls. However, instead of putting the words under the letter in the manner that they are spelled, they are placed by beginning sound. Under *Ff*, the teacher would place the words *fat*, *five*, *finger*, but also *phone* and *photo*. Teachers would then discuss with students the type of sound (*f* is a fricative sound and *k* is a stop sound) or how the sound is made in the mouth (placement of tongue, teeth and/or voiced or voiceless phonemes). In the older grades, words can be categorized by the focus of the lesson. For example, using the /f/ sound the words *fat*, *phone*, *graph*, and *puff* would be together for the spellings of the /f/ sound is *f*, *ph*, *gh*, and *ff*.

Word Ladders

Word Ladders were created by Timothy Rasinski to support students to manipulate phonemes to add, delete, substitute, or rearrange letters to create words that match the definition given. As can be seen in examples one and two of Figure 2, only one letter is changed to make the next word (Padak & Rasinski, 2009), but other more advanced variations are available for older students. The goal is for younger students to see how changing one or more letters creates a new word. In teacher-made word ladders, the teacher gives the first word, spelled correctly, to the students. With more advanced word ladders (like example 3), clues or definitions are used to help the students know which letters to add or remove to make the next word.

Figure 2
Word Ladder Examples

	Example 1	**Example 2**	**Example 3 – more advanced**
First word	Cat	dog	dish
Second word	Rat	log	dash
Third word	Ran	lag	slash
Fourth word	Ram	lap	slosh
Fifth word	Pam	cap	slob

The word ladders can keep going as long as you need them to go. In general, no longer than 10 or 11 words in any given word ladder.

Fluency

Like phonemic awareness and phonics, fluency, vocabulary, and comprehension must also be systematically and explicitly taught. Fluency research has shown that systematic explicit instruction is a very important part of the reading program and should not be skipped. Fluency is complex and multifaceted, it can be defined as "the accurate reading of connected text at a conversational rate with appropriate prosody" (Honig, Diamond, & Gutlohn, 2018, p. 322). Fluency has four components: accuracy, rate, automaticity, and prosody (Rasinski, 2012). Accuracy is the ability to decode correctly. Rate is reading text at a speed that models a conversational manner. Automaticity is the reading of words quickly and effortlessly in or out of context. Prosody is reading with expression. Prosody requires students to pay attention to intonation, stress, and expression. Intonation is using pitch and timbre to accent the rise and fall of the voice while reading aloud. Stress is using length and loudness to emphasize important sounds or words. Expression is used to show emotion and to keep the audience interested. Activities for vocabulary instruction include: 1) Read Alouds, 2) Echo Reading, and 3) Choral Reading.

Read Alouds

There are several ways Read Alouds can increase fluency and comprehension (Wright, 2014). First, it is important for all students to hear a model of good fluent reading. This model can be demonstrated from hearing teachers or capable peers reading accurately and with prosody or expression. Another way Read Alouds can increase fluency is when there is a word or sentence that is repeated in the story. The students seem to naturally pick up on the repetition and start to say the repeated word or sentence altogether in a fluent manner. For example, during a Read Aloud of *The Three Little Pigs*, the students might chime in on the repeated phrase "I'll huff and I'll puff and I'll blow your house down". In addition, if the Read Aloud topic is covered in multiple readings, the teacher has the added benefit of increasing background knowledge, which benefits comprehension. Readers Theatre can be a natural outcome of Read Alouds (Heinemann, 2023; Rasinski et al., 2017). Teachers can ask a few students to prepare a section of the story to present to the class during the read aloud. This activity can add more fluency practice into the lesson. It can also add some enthusiasm to the read aloud lesson that increases student engagement. Have students choose a small section of the book with some dialog and add a narrator to read the parts that are not dialogue.

Echo Reading

Teachers can model fluency and help students improve in this area by a strategy called "Echo Reading." In Echo Reading, the teacher reads aloud either a line or a sentence explicitly modeling good fluency. Then the students echo back using the same rate and prosody modeled by the teacher. The teacher chooses a story for a Read Aloud such as *Mufaro's Beautiful Daughters* by John Steptoe (1987). In this story when haughty Manyara speaks to kind Nyasha, the teacher could read aloud in a sarcastic tone: "Because everyone talks about how kind *you* are, and they praise everything you do" modeling an arrogant attitude. Students have many opportunities to practice fluency when participating in Echo Reading.

Choral Reading

Teachers often use choral reading to help students build fluency. Choral reading is reading aloud in unison as a whole class or small group (Paige, 2011). Besides helping to increase fluency, choral reading also builds self-confidence and motivation. Choral reading may be used for reading poems. An example is found in "Annabelle Lee" by Edgar Allen Poe or "Stopping by the Woods on a Snowy Eve" by Robert Frost. Complexity can be added by dividing students into 2 or 3 groups and assigning certain words or lines to different groups. This concept can be seen in the following first stanza:

Teacher: Whose woods these are I think I know.
Group 1: His house is in the village though;
Group 2: He will not see me stopping here
Group 3: To watch his woods fill up with snow.

Vocabulary

The knowledge of words and their meanings is the very definition of vocabulary (Honig et al., 2018). Without knowing the meanings of words, perfect decoding and phonics skills are worthless. How many teachers have had students who can decode and read a passage fluently, but do not demonstrate any understanding of what the passage means? Since comprehension is the end goal of all literacy instruction, the teacher must not stop with just phonics.

Lehr et. al (2004) discuss using a generative or schematic approach to vocabulary development. This approach involves helping students recognize word families and using derivational relationships to help students determine the meaning of unknown words as well as how to spell words (i.e.: wise – wisdom). Researchers have found that using a direct teaching of word learning strategies increases a students' ability to be independent word learners. These strategies include using dictionaries, identifying and using appropriate context clues, and morphology.

While students do acquire words outside of school, teachers should teach the key vocabulary for the story or content area. This vocabulary should be taught explicitly and systematically while also increasing a student's word consciousness. Activities for vocabulary instruction include 1) Hink Pinks, Hinky Pinky, and Hinkety Pinkety, 2) Word-Part Clue Evaluation, and 3) the T-FIVE Model.

Hink Pinks, Hinky Pinky, and Hinkety, Pinkety

Hink Pinks, Hinky Pinky, and Hinkety Pinkety are phonograms or a pair of rhyming words that are answers to a riddle (Buchoff, 1996; Cavanaugh, 2011). This activity helps develop word consciousness (Lehr et al., 2004). A hink pink is a pair of one-syllable rhyming words. For example, the riddle *What is an overweight animal with fur* can have the answer *fat cat* or *fat rat*. A hinky pinky is a pair of two-syllable rhyming words that answer the riddle. An example would be, *What is a young cat in love*? with the answer being *smitten kitten*. Finally, the hinkety pinkety activity has riddle answers that are three-syllables. The riddle *What do you call two drums talking?* would be *percussion discussion*. Students not only need to know how many syllables are in words (a phonological awareness skill) but also the meanings of the words. Once students become familiar with this activity, they enjoy creating their own riddles to share with their peers and their teacher.

Word-Part Clue Evaluation

Another vocabulary activity that also addresses morphology is Word-Part Clue Evaluation. Researchers recommend that teachers teach derivational affixes because they usually are regular in meaning (Edwards et.al, 2004). In this activity, students are given or draw a five-column chart like the one pictured in Figure 3. Students analyze the words given to determine if the word has an affix or not and if the affix influences the meaning of the word.

Figure 3
Word-Part Clue Evaluation for Prefixes

Word	Does Not Have Prefix and Root Word	Has Prefix and Root Word	Prefix + Root Word = Meaning	Prefix + Root Word ≠ Meaning
united	u + nit + ed			
increase		in + crease		to become greater in number
infinite		in + finite	not finite, not limited	

T-Five Model

The T-FIVE Model is a way for teachers to ask open ended higher order thinking and probing type questions (Knaebel et al., 2015). T-FIVE is an acronym that stands for Topic, Fact, Inference, Vocabulary, and Evaluation. More details about the T-FIVE model can be found in the Comprehension section below. While all these question types can be asked after reading, vocabulary questions can and should be asked during reading. Vocabulary words should be carefully selected before reading and definitions should be shared for words as they are used in context. This is an important step to scaffold word meaning in order to build background knowledge. Greater background knowledge increases comprehension.

Comprehension

The ultimate goal of literacy instruction, or indeed any instruction, is comprehension. Without it, reading is a useless use of time. Being able to read fluently does not automatically mean the student understands what is read. Read the following excerpt:

> A handle service can be composed of one or more sites. Sites can be primary or mirror. Mirror sites replicate the handle records stored on the primary sites. Typically, a service has a single primary, but it is possible to have a service with multiple primaries which then replicate from each other. Replication as implemented in the software offers eventual consistency. (Sample Templates, 2023, para. 3).

While each of these words are easily decoded by proficient readers, would you be able to discuss the topic showing deep understanding?

Comprehension is defined by Harris and Hodges (1995) as the reader having a reciprocal interchange with the text as they build an understanding of the message of the text. The building blocks of comprehension are: fluency, vocabulary, world knowledge, comprehension strategies, and motivation (Honig et al., 2018).

Activities to help you teach comprehension in the regular classroom include 1) Question-Answer Relationship (QAR), 2) Think-Aloud, 3) the T-FIVE Model, and 4) Teaching Inferences. Remember, the key to teaching is systematic, explicit instruction.

Question-Answer Relationship (QAR)

According to NRP (2000), teaching students how to answer comprehension questions effectively is an important part of instruction. QAR is a technique that was developed by Taffy Raphael (1986). This strategy teaches students how to approach answering questions based on text they just read. In QAR there are 4 types of questions in 2 categories. The first category of *In the Text* has the two types of questions called *Right There* and *Think and Search*. The second category of *In My Head* has two types of questions called *Author and Me* and *On My Own*. This strategy provides students and teachers with common terminology for discussing how to answer questions.

Figure 4
QAR examples for "Last Stop on Market Street"

In the Text	In My Head
Right There	**Author and Me**
What are CJ and Nana doing at the soup kitchen?	What was CJ using to "see" these things when his eyes were closed?
Think and Search	**On My Own**
Who is Nana?	How can you serve others?

Think-Aloud

Think Aloud activities are good activities that teachers can use to demonstrate how good readers think when they are reading connected text (Block & Isreal, 2004). In this strategy, the teacher demonstrates while the students watch and listen. In this strategy the questions are rhetorical, and the teacher answers the questions aloud. The best time for a think aloud is directly after explicit instruction (Smeckens, 2019). After the direct instruction, the teacher uses a think aloud to "reveal how to execute the new skill as plainly, clearly, and precisely as possible" (para. 1).

Using *Charlotte's Web* (1952) to teach similes, read aloud the first paragraph of chapter 11. Then state:

Teacher: "The grass looked like a magic carpet." [stop reading and look up at the ceiling].

Teacher: "I wonder why the author tells us the grass was a magic flying carpet." [pause but do not call on students to answer]

Teacher: I don't think the grass is really a magic carpet. So, what do I think the author means?

Teacher: To answer my own question, I am looking at the words the author uses.

Teacher: Wait! I should stop and reread from the beginning on the paragraph [reread the paragraph].

Teacher: I wonder if the grass would look like a magic carpet from the fog and dew.

Teacher: I remember yesterday when we were learning about similes. Similes compare two things using the word *like* or *as*.

Teacher: I see the word like in that sentence. [reread the sentence again]
Teacher: I know! The author is using a simile to show that the wet grass was shiny and bright like a magic carpet might be.

T-Five Model

The T-FIVE Model is a way for teachers to ask open ended higher order thinking and probing type questions (Knaebel, Bauserman, & Quatroche, 2015). The researchers found that practice over time increased comprehension scores, especially on the higher order thinking and probing questions. As stated above, T-FIVE is an acronym that stands for Topic, Fact, Inference, Vocabulary, and Evaluation. It is important to plan ahead what questions you will be asking and to make sure that the students cannot answer the question with a *yes* or a *no*. The following chart shows examples of each type of question.

Figure 4
Examples of T-FIVE Questions

T-FIVE	Example Questions based on *Mufaro's Beautiful Daughters: An African Tale* by John Steptoe	Example Questions based on Chapter 23 of *I am Malala* by Malala Yousafzai
Inference	• What would have happened if Manyara had waited and gone to the king with her family?	• Malala always ran late. What would have happened if Malala had missed the bus that day?
Vocabulary	• What does "temper" mean? • What is "millet"?	• The author uses the word "dyna." What does this word mean in the story?
Fact	• Who did Manyara meet first on her way to the king? • Who did Nyasha sing to in her garden?	• What exam was Malala studying for? • What was the name of the snack factory they pass?
Topic	• What was this story about? • What was the best part of this story?	• What happened in this chapter? • What was the main idea?
Evaluation	• What would you do if you were traveling with your family, and you met a boy who needed some food?	• What would you have done if you were in the same position as Malala?

Teaching Inferences

Teaching inferences is a very important skill that can enhance student comprehension. As little as 10 weeks of practice can help students make big gains on comprehension assessments (Hwang, et al, 2023). Inferencing involves activation of background knowledge and integration of background knowledge with what the author tells us to create an inference. Inferencing can be taught during Read Aloud lessons (see above) using T-FIVE questions (see inferencing in chart above) and Think Alouds (see script above) as strategies for explicit instruction and practice. Read Aloud texts should be carefully selected so that they offer opportunities for inferencing. Inference questions should be carefully planned before sharing the reading (see T-FIVE questions). Scaffolding and Think-Alouds are important strategies to teach inferencing.

Conclusion

     In conclusion, the use of the activities shared in this article, if delivered in a systematic, explicit manner, should be tools for teachers to use to help the students in their classroom to comprehend. If students are reading and comprehending, then the downward trend on the average fourth grade NAEP scores should halt and start to go upward. And while this upward trend in a national assessment is nice, the real accomplishment and point of pride will be Hoosiers who can read.

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