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Science of Reading

EDITOR'S NOTE

Learning to read relies on proven techniques. This Spotlight will help you understand new state laws on evidence-based instruction; explore the science behind how kids learn to read; identify the potential gaps in your staff's knowledge on the science of reading; and consider the difficulties involved with teaching reading.

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More States Are Making The 'Science of Reading' a Policy Priority

By Sarah Schwartz

As states have crafted plans for addressing the academic disruptions caused by the coronavirus pandemic, one area has emerged as a policy priority: early reading instruction.

At least 18 states and the District of Columbia have said that they plan to use COVID-19 relief funding through the American Rescue Plan or previous aid packages to support teacher training or instruction in evidence-based approaches to early literacy. Four states have passed new laws or enacted regulations that mandate teachers be taught, and use, techniques that are grounded in the large body of research on how children learn to read.

While some of these developments are designed to support students with pandemic-interrupted education, they're also part of years-long legislative momentum on expanding research-based reading instruction that started pre-COVID, said Kymyona Burk, the policy director for early literacy at ExcelinEd, an advocacy group founded by Jeb Bush, Florida's former governor. Burk was previously the Mississippi Department of Education's state literacy director, leading the implementation of Mississippi's Literacy-Based Promotion Act.

In early 2020, Education Week reported that at least 11 states had enacted laws aimed at expanding evidence-based early instruction in grades K-3 over the past three years.

There's a large, established body of research in psychology, human development, and cognitive science focused on how people learn to read. This literature spans many processes, from vocabulary acquisition to comprehension to the role of background knowledge. One of the key findings in this research, though, relates to foundational reading skills, which allow children to decipher print.

Decades of studies have shown that explicitly and systematically teaching students which sounds represent which letters—teaching them phonics—is the most effective way to get them reading words. But as reporting from Education Week and other outlets has demonstrated, many teacher preparation programs don't teach their students how to deliver this kind of instruction.

State Laws or Actions on 'Science of Reading'

State	Description
Pennsylvania	In September, the Pennsylvania state board of education required that teacher preparation programs in the state include instruction in "structured literacy" for all certification programs in early childhood, elementary/middle, special education, English as a second language, and reading specialist. The board also required that in-service teachers in these areas be trained in "structured literacy." The term is defined by the board as "systemic, explicit instruction that provides a strong core of foundational skills in the language systems of English," and integrates listening, speaking, reading, writing, and spelling.
Arkansas	The state made three-cueing illegal in April, with the passage of a law that banned schools from using the "three-cueing system model of reading based on meaning, structure and syntax, and visual, which is also known as 'MSV.'" The law also banned schools from using instruction that relies on "visual memory as the primary basis for teaching word recognition." Schools that violate the law could lose 10 percent of their state funding.
Connecticut	A law passed in June required the state department of education to develop a research-based reading plan to improve performance for struggling students, and to establish a Center for Literacy Research and Reading Success. By July 2022, the Center has to approve at least five evidence-based reading curriculum models or programs, and at least five assessments. Starting in the 2023-24 school year, districts have to use approved curricula and assessments.
North Carolina	Passed in April, North Carolina's new reading law requires educator preparation programs in the state to train elementary teachers in the science of reading, and it requires continuing education credits in courses "grounded in the science of reading" for teacher license renewal. The law also mandates that schools design "Individual Reading Plans" for struggling students in K-3.

A Flourish data visualization

How schools are using COVID relief funds for reading

At least 18 states and the District of Columbia have all said that they plan to use American Rescue Plan funds or other COVID stimulus money to further the "science of reading" or support other evidence-based early literacy work.

North Carolina's law, passed in April 2021, requires teacher training in the "science of reading," while in Pennsylvania, teacher preparation programs are now mandated to teach "structured literacy"—defined as a "strong core" of foundational skills integrated alongside instruction in listening, speaking, reading, writing, and spelling.

Also in 2021, Arkansas banned three-cueing, a practice of word identification that encourages students to rely on pictures and context to decipher words, not just letters. Connecticut passed a law requiring schools to use "evidence-based" reading materials, to be selected from an approved list drawn up by a department of education committee.

While many reading researchers agree that many teachers could benefit from more training in evidence-based methods, some also voiced concerns about the unintended consequences of using legislation as a lever for change.

"Legal remedies are a clumsy, heavy-handed tool. If you write a law saying you can't use three-cueing approaches, that's easy to evade and difficult to enforce," said Mark Seidenberg, a professor at the University of Wisconsin-Madison who studies reading.

On the other hand, he said: "Nothing else was working. And the laws are having some impact."

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Legislation makes promises but has limits

Mandating that teachers use "evidence-based" methods isn't a new phenomenon, said P. David Pearson, a reading researcher and emeritus faculty member at the University of California, Berkeley, Graduate School of Education.

Reading First, the George W. Bush-era grant program authorized under the No Child Left Behind Act of 2002, required schools to use "scientifically based reading research" to receive grant funding.

But critics of the program argued that its implementation put too much focus on one area of the science—foundational skills instruction—leaving teachers without enough time to work with young students on other key components of literacy instruction, like building vocabulary and background knowledge and developing comprehension skills.

With these new policies, states and districts should take care not to repeat this pattern, said Claude Goldenberg, a professor emeritus at Stanford University who studies early literacy development in English-language learners. "We need to learn from things that don't work out, even if experiments say they should," he said.

New state laws or actions on 'Science of Reading'

But Burk, of ExcelinEd, said it's crucial to help teachers develop a common understanding of how children learn the foundations of reading—an understanding that often isn't taught in their preparation programs or in professional development.

"With legislation, we can ensure that these things are happening everywhere," she said. Some laws, like North Carolina's, write in this support for teachers through professional development, and detail how the state will hold teacher preparation programs accountable for conveying this information.

Fostering teacher buy-in will be crucial, said Pearson. "Programs that engage the teachers and help them develop ownership of it, [that] make them responsible for implementation and monitoring one another, create a system that becomes self-monitoring. Reform efforts that don't take into account the social and cultural facets of learning are, I think, never going to be effective."

Laws like the one in Arkansas, which bans three-cueing, also put pressure on curriculum publishers to align to evidence-based practice, said Seidenberg: "If they want to continue selling their products in those markets, they are going to have to change enough to satisfy the stipulations in those laws."

Aligning materials will be the next task for these states, Burk said. "We are teaching teachers how to teach reading, and then they're going back into their classrooms and looking at their materials and saying, 'This doesn't line up.'" ■

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How Do Kids Learn to Read? What the Science Says

By Sarah Schwartz & Sarah D. Sparks

How do children learn to read?

For almost a century, researchers have argued over the question. Most of the disagreement has centered on the very beginning stages of the reading process, when young children are first starting to figure out how to decipher words on a page.

One theory is that reading is a natural process, like learning to speak. If teachers and parents surround children with good books, this theory goes, kids will pick up reading on their own. Another idea suggests that reading is a series of strategic guesses based on context, and that kids should be taught these guessing strategies.

But research has shown that reading is not a natural process, and it's not a guessing game. Written language is a code. Certain combinations of letters predictably represent certain sounds. And for the last few decades, the research has been clear: Teaching young kids how to crack the code—teaching systematic phonics—is the most reliable way to make sure that they learn how to read words.

Of course, there is more to reading than seeing a word on a page and pronouncing it out loud. As such, there is more to teaching reading than just teaching phonics. Reading requires children to make meaning out of print. They need to know the different sounds in spoken language and be able to connect those sounds to written letters in order to decipher words. They need deep background and vocabulary knowledge so that they understand the words they read. Eventually, they need to be able to recognize most words automatically and read connected text fluently, attending to grammar, punctuation, and sentence structure.

But knowing how to decode is an essential step in becoming a reader. If children can't decipher the precise words on the page, they'll never become fluent readers or understand the passages they're reading.

That's why we've put together this overview of the research on early reading, in grades K-2. It covers what's known about how we should teach letter-sound patterns, and what we don't know for sure yet. It touches on what else should be part of early reading programs. And it explains why we know that most children can't learn to read through osmosis or guessing.

Here's what the evidence shows.

Don't children learn to read the way they learn to speak?

Infants learn to speak by listening to and repeating sounds made by adults and connecting them to meanings. They don't consciously distinguish individual sound units (called phonemes) when hearing spoken language. Some research suggests infants learn probabilistically—for example, hearing the sound "ball" at the same time as the sight of a round, bouncy object over time makes the child associate the two—while other studies suggest children map meaning to a word after experiencing it just

once or twice. Within the first two years, typically developing toddlers' brains focus on the most common sounds in their native languages and connect those sounds to meaning. A child develops understanding of speech through exposure to language and opportunities to practice the "serve and return" patterns of conversation, even without explicit instruction.

By contrast, children do not naturally develop reading skill through exposure to text. The way they learn to connect oral and written language depends on what kind of language they are learning to read.

Alphabetic languages, like English or French, use letters to stand for sounds that make up spoken words. To read an alphabetic language, children must learn how written letters represent spoken sounds, recognize patterns of letter sounds as words, and match those to spoken words whose meanings they know. This differs from Chinese, for example. It uses a tonal spoken language, conveying meaning with small differences in stress or pitch. Its writing system is partially logographic—in which written symbols correspond directly to a word or concept—and also includes words that couple symbols for meaning and symbols for sound. Someone reading Chinese hanzi characters could not "sound out" unfamiliar words character by character.

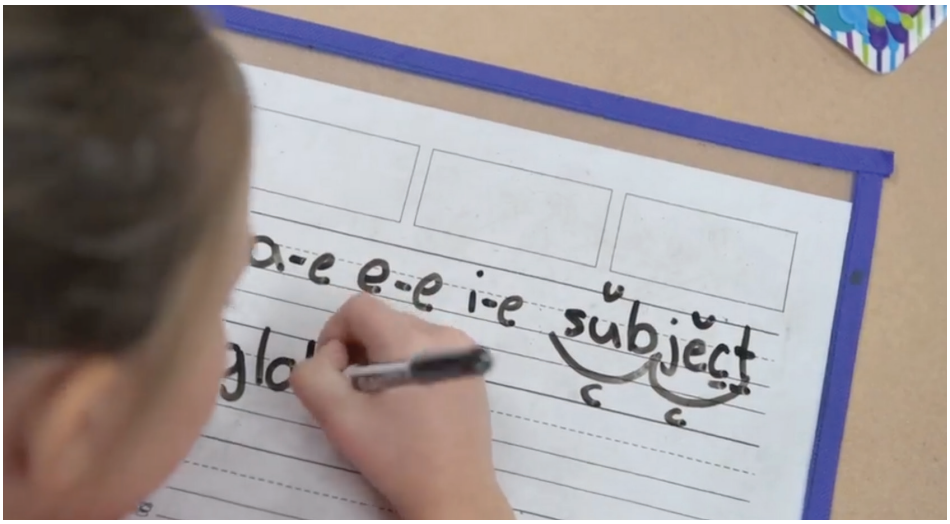
What is systematic, explicit phonics instruction, and why is it important?

Connecting printed letters on a page to written sounds isn't intuitive. While some young children may make those connections themselves, most do not. One set of studies from 1989-90 illustrates this phenomenon well.

In these studies, conducted by Brian Byrne and Ruth Fielding-Barnsley, researchers taught young children between ages 3 and 5 to read whole words aloud, like "fat" and "bat." These children didn't already know their letter names.

Then, the researchers tested whether the children could transfer their knowledge to reading a new word. They gave them the word "fun," and asked whether the word was "fun" or "bun." Very few of the students could do this successfully. They couldn't break down the original word into phonemes and then transfer their knowledge of those phonemes to a new word.

But children could succeed on this task if they were first given some explicit instructions. When children were taught how to recognize that certain letters represented certain sounds, and taught how to segment words to identify those individual letters and sounds,



—Edweek video: What the Science Says About How Kids Learn to Read

The debate on how to teach early reading has raged for a century. But for the last few decades, the cognitive science has been clear: Teaching young kids how to crack the code—teaching systematic phonics—is the most reliable way to make sure that they learn how to read words.

they had much greater success on the original transfer test. Neuroscience research has since confirmed and helped explain these findings. When learning how to read new words in an unfamiliar made-up language, participants had more long-term success if they were first taught which symbols correspond to which sounds, than if they tried to remember words as wholes. Brain imaging of these readers finds that the two teaching strategies tap into different neural pathways in the brain. Readers taught to connect print to meaning directly could recall words initially more quickly, but less accurately; readers taught to connect print to sound and then to meaning read aloud more quickly and correctly, better recalled the correct meanings of words, and transferred their knowledge to new words.

Decades of research has shown that explicit phonics instruction benefits early readers, but particularly those who struggle to read.

That's because small strengths or deficits at the start of reading compound over time. It's what reading expert Keith Stanovich in 1986 dubbed the "Matthew Effect in Reading," after the Bible verse in which the rich get richer and the poor get poorer: "The combination of deficient decoding skills, lack of practice, and difficult materials results in unrewarding early reading experiences that lead to less involvement in reading-related activities," Stanovich wrote. "Lack of exposure and practice on the part of the less-skilled reader delays the development of automaticity and speed at the word recognition level. Slow, capacity-draining word-recognition processes require cognitive resources that should be allocated to comprehension. Thus, reading for meaning is hindered; unrewarding reading experiences multiply; and practice is avoided or merely tolerated without real cognitive involvement."

My reading curriculum includes letter-sound instruction. Am I providing enough phonics?

Not all phonics instruction is created equal.

The most effective phonics programs are those that are systematic. The National Reading Panel found this in 2000, and since then, further research reviews have confirmed that this type of instruction leads to the greatest gains in reading accuracy for young students.

A systematic phonics program teaches an ordered progression of letter-sound correspondences. Teachers don't only address the letter-sound connections that students stumble over. Instead, they address all of the combinations methodically, in a sequence, moving on to the next once students demonstrate mastery. Teachers explicitly tell students what sounds correspond to what letter patterns, rather than asking students to figure it out on their own or make guesses.

In one series of experiments, Stanford University neuroscientist Bruce McCandliss and his colleagues made up a new written language and taught three-letter words to students either by asking them to focus on letter sounds or on whole words. Later, the students took a reading test of both the words they were taught and new words in the made-

up language, while an electroencephalograph monitored their brain activity. Those who had focused on letter sounds had more neural activity on the left side of the brain, which includes visual and language regions and is associated with more skilled reading. Those who had been taught to focus on whole words had more activity on the right side of the brain, which has been characteristically associated with adults and children who struggle with reading. Moreover, those who had learned letter sounds were better able to identify unfamiliar words.

Early readers benefit from systematic phonics instruction. Among students in grades K-1, phonics instruction led to improvements in decoding ability and reading comprehension across the board, according to the National Reading Panel. Children at risk of developing future reading problems, children with disabilities, and children from all socio-economic backgrounds all benefited. Later research reviews have confirmed that systematic phonics instruction is effective for students with disabilities, and shown that it also works for English-language learners.

Most studies of phonics instruction test its immediate effectiveness—after the intervention, are children better readers? Among students in older grades, the results are less clear. A recent meta-analysis of the long-term effects of reading interventions looked at phonics and phonemic awareness training, mostly in studies with children in grades K-1. Both phonics and phonemic awareness interventions improved reading comprehension at an immediate posttest. But while the benefits of phonemic awareness interventions persisted in a follow-up test, the benefits of phonics interventions faded much more over time. The average length of all interventions included in the study was about 40 hours, and the follow-up assessments were conducted about a year after the interventions were complete, on average.

Some of my students didn't need phonics instruction to learn to read. Why are you saying that all kids benefit?

Depending on the estimate, anywhere from 1 percent to 7 percent of children figure out how to decode words on their own, without explicit instruction. They may spot the patterns in books read to them or print they see in their environment, and then they apply these patterns. These include children with a neurotypical form of "hyperlexia"—a condition in which children may begin decoding as early as 3—but this is more frequently associated with children who have autism-spectrum disorders and often have separate problems with reading comprehension.

It may seem like these children are reading words as whole units, or using guessing strategies to figure out what comes next in the story. But they are attending to all of the words' individual letters—they're just doing it very quickly.

A systematic phonics program can still benefit these students, who may have gaps in their knowledge of spelling patterns or words that they haven't encountered yet. Of course, phonics instruction—like all teaching—can and should be differentiated to meet the needs of individual students where they are. If a student can demonstrate mastery of a sound, there's no need to continue practicing that sound—he or she should move on to the next one.

There's another answer to this question: Students may look like they're decoding when they're actually not. For example, a child may see an illustration of an apple falling from a tree, and correctly guess that the sentence below the picture describes an apple falling from a tree. This isn't reading, and it doesn't give the teacher useful information about how a student will tackle a book without pictures.

Can cueing strategies help students to read?

Many early reading classrooms teach students strategies to identify a word by guessing with the help of context cues. Ken and Yetta Goodman of the University of Arizona developed a "three-cueing system," based on analysis of common errors (or "miscues") when students read aloud. Ken Goodman famously called reading development a "psycholinguistic guessing game," and cueing systems teach students to guess at a new word based on:

- Meaning/Semantics, or background knowledge and context, such as vocabulary a student has already learned;
- Structure/Syntax, or how the word fits in common grammar rules, such as whether the word's position in a sentence suggests it is a noun, verb, or adjective; and
- Visual/Graphophonics, or what a word looks like, such as how upper- and lowercase letters are used (suggesting a proper noun, for example) or common spelling patterns.

Cueing systems are a common strategy in whole-language programs, and also are used in many "balanced literacy" programs that incorporate phonics instruction. Cueing systems were designed by analyzing errors rather than practices of proficient readers, and have not shown benefits in controlled experiments.

Moreover, cognitive and neuroscience studies have found that guessing is a much less efficient way to identify a new word, and a mark of beginning or struggling readers, not proficient readers. Skilled readers instead sound out new words to decode them.

Balanced literacy programs often include both phonics and cueing, but studies suggest cueing instruction can make it more difficult for children to develop phonics skills because it takes their attention away from the letter sounds.

> "Early readers benefit from systematic phonics instruction. Among students in grades K-1, phonics instruction led to improvements in decoding ability and reading comprehension across the board, according to the National Reading Panel."

I know phonics instruction is supposed to be explicit and systematic. But beyond that, how should I teach it? Does the research say anything about what content I need to cover, and how should it be sequenced?

There is a general path that most children follow as they become skilled decoders. Research can tell us how children usually progress along this path, and which skills specifi-

cally predict better reading performance.

Before starting kindergarten, children generally develop some early phonological awareness—an understanding of the sounds that make up spoken language. They can rhyme, break down multi-syllable words, and recognize alliteration.

A next step in the process is understanding that graphemes—combinations of one or more letters—represent phonemes, the smallest units of spoken language. It's easier for students to learn these letter-sound correspondences if they already have early phonological skills like rhyming and alliteration, along with knowledge of the names of the letters of the alphabet.

And while vocabulary is important for reading comprehension, research has also found that it's a component in decoding ability. One study found that when children know a word's meaning, they can more quickly learn how to recognize it automatically, because the visual letters, corresponding sounds, and meaning all map together when a reader recognizes a word.

There are other early skills that relate to later reading and writing ability as well, regardless of IQ or socio-economic status. Among these are writing letters, remembering spoken information for a short time, rapidly naming sequences of random letters, numbers, or pictures, and other phonological skills—like the ability to segment words into phonemes.

To decode words, students need to be taught to blend together the phonemes that graphemes represent on the page. For example, a young reader must learn to recognize that /r/, /o/, /d/ are three sounds that together form the word "rod," but also that the word "rock" also contains three sounds, /r/, /o/, /k/ This is a process that builds on itself rapidly. Though there are some 15,000 syllables in English, after a child has learned the 44 most common sound and letter combinations, they will begin to sound out words as they read. These include both the basic letter and vowel sounds, but also common combinations such as "th," "sh," and "-ing." There are two main ways to demonstrate to children that words are made up of sound-letter correspondences. In one method, students learn the sounds of the letters first and then blend these phonemes together to sound out words. That's synthetic phonics—they're synthesizing phonemes into greater whole words. The other method, analytic phonics, takes an inverted approach: Students identify—or analyze—the phonemes within words, and then use that knowledge to read other words.

Take the word "bat." In synthetic phonics, students would first learn the /b/ sound, then the /a/ sound, then the /t/ sound and blend them together to sound out "bat." In analytic phonics, students would learn the word "bat" alongside words like "cat," "mat," and "hat," and would be taught that all these words end in the "at" sound pattern.

So there's synthetic phonics and analytic phonics—is one way better than the other?

A few studies have found synthetic phonics to be more effective than analytic phonics. Most notably, a seven-year longitudinal study from Scotland found that synthetic phonics taught in 1st grade gave students an advantage in reading and spelling over analytic phonics. Still, when examined as a whole, the larger body of reading research doesn't surface a conclusive winner. Two landmark research reviews haven't found a significant difference in the effectiveness of the two methods. Other more recent research is still inconclusive.

Do these strategies apply to words that don't follow traditional sound-spelling patterns? What about words like "one" and "friend"—can those words still be taught with phonics?

Yes, but not alone; spelling and semantic rules go hand-in-hand with teaching letter sounds. Words like "lime" and "dime," have similar spelling and pronunciation. But some words with similar spelling have different pronunciations, like "pint" and "mint." And others have different spellings and similar pronunciations, like "jazz" and "has." Brain imaging studies find that when readers see word pairs that are inconsistent, they show greater activity in the areas of the brain associated with processing both visual spelling and spoken words. This shows that young readers use systems of understanding of both printed shapes and sounds when they see any written word. When those two systems conflict, the reader may call on additional rules, such as understanding that words at the end of lines of a rhyming poem (such as "has" and "jazz") likely rhyme even if their spelling would not suggest it.

Some research has found that teaching common irregular words, like "one" and "friend," as sight words can be effective. Still, in these studies, children were also taught phonics along with sight words—and that's important. Understanding phonics gives students the foundation to read these irregular words. Take "friend." While the "ie" doesn't produce the same sound it normally does, the other letters in the word do. Research has suggested that children use the "fr" and the "nd" as a framework when they remember how to read the irregular word "friend."

"Before starting kindergarten, children generally develop some early phonological awareness—an understanding of the sounds that make up spoken language. They can rhyme, break down multi-syllable words, and recognize alliteration."

When should children start to learn how to sound out words? Is there a "too early"?

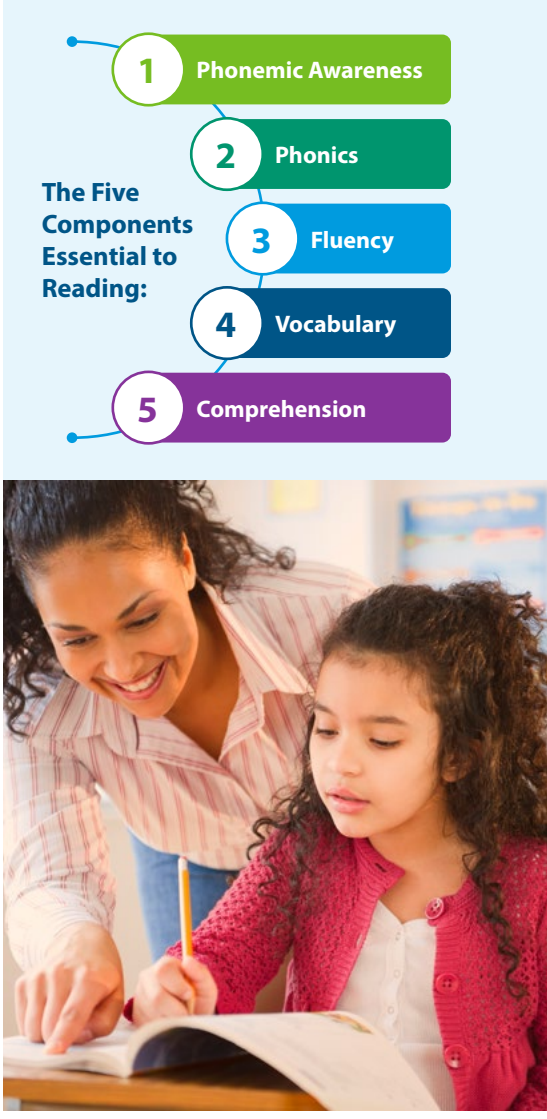
Even very young children can benefit from instruction designed to develop phonological awareness. The National Early Literacy Panel Report (2009), a meta-analysis of early literacy studies, found that teaching preschoolers and kindergartners how to distinguish the sounds in words, whether orally or in relationship to print, improved their reading and writing ability. The children in these studies were generally between the ages of 3 and 5.

Studies suggest progress in phonics is less closely linked to a child's age than to the size and complexity of their spoken vocabulary, and to their opportunities to practice and apply new phonics rules. There is some evidence

The Gold Standard in Literacy Research

Spanning multiple decades, the science of reading is a body of research about how humans learn to read. Whereas spoken language typically comes naturally, people need to be taught to understand written language. The science of reading has revealed several key findings, including why students may not learn to read and the kind of instruction that'll most effectively get them on a path to literacy.

Concerningly, about 20% of elementary school students have serious problems learning to read, and at least another 20% are at risk of not meeting grade-level expectations. Still, only 5% of young readers have cognitive impairments severe enough to prevent them from acquiring the skills they need to become fluent readers. This means high-quality, evidence-based instruction can greatly impact many students' learning trajectories. That's where we—their teachers—come in.



The Role of Teachers

Just as learning to read is a complex process, teaching someone to read is as well. Classroom instruction is the most critical factor in preventing reading challenges; however, only 51% of higher education teaching preparation programs include the science of reading. If teachers don't know the science of reading, they cannot impart its methods.

This much requires a commitment on the part of schools and districts. It's not enough to announce a switch to scientifically based reading instruction. We must invest in educating our teachers before investing in programs; the latter is only a tool. Teachers must first understand the *what*, *why*, and *how* behind the science of reading. Therefore, ongoing professional learning must be introduced.

What Is Structured Literacy—and What Is Not?

The application of the science of reading is called Structured Literacy. The name was introduced by the International Dyslexia Association® (IDA) to differentiate it from reading instruction and programs that aren't wholly based in the evidence of the science of reading—but wrongfully claim to be.

It's important, then, to know the two hallmarks of Structured Literacy. To qualify, a program must:

- Teach all the components found to be foremost in ensuring reading success
- Employ the principles that align to the necessity of each component

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Putting Structured Literacy into Practice

Evidence informs how Structured Literacy should be taught. Based on the science of reading, we know decoding (word recognition) and linguistic, or language, comprehension are the two skills critical to reading comprehension. Structured Literacy emphasizes both components because inefficiency in one may lead to overall reading failure.

The Critical and Underpinning Components of Structured Literacy

Decoding:
Phonology
Orthography
Morphology

Linguistic comprehension:
Syntax
Semantics
Pragmatics
Discourse

Across all grade levels, Structured Literacy is characterized by these four principles. Instruction must be:

1. **Explicit:** Concepts and skills are taught directly and are practiced.
2. **Systematic:** Concepts and skills are logically ordered from simple to complex.
3. **Cumulative:** New learning builds on prior learning.
4. **Diagnostic/Responsive:** Students' needs and strengths are identified, and instruction is designed accordingly.

Dyslexia and Structured Literacy

As mentioned previously, the number of students struggling to read is not indicative of the number of students whose ability to read is severely impaired. Dyslexia, for example, is characterized by difficulties with accurate or fluent word recognition and by poor spelling and decoding abilities. Often, though, this is unexpected in relation to the student's other cognitive abilities. So, with language-based instruction and consistent support, these difficulties can be overcome.

The systematic decoding strategies of Structured Literacy, which are not emphasized by other popular reading approaches, are especially important for students with or at-risk of dyslexia. These students, who needed extra support before the pandemic, are likely to have fallen further behind since. Research- and evidence-based practices, such as those provided by Voyager Sopris Learning®, are what educators need to teach reading effectively. Plus, due to their proven efficacy in achieving desirable outcomes, ESSER funds can be used to invest in these solutions.

Unlocking Academic Potential

As students get older, academic success in all subjects is contingent upon being able to read and comprehend new material. Reading instruction informed by the science of reading is the only proven way to help struggling readers achieve proficiency—and to help all readers advance their skills.

The impact of the pandemic on young learners is apparent, but without proper intervention, we may not realize the depth of the problem. High-quality instruction starts with administrators and educators committing to the science of reading and Structured Literacy. Only then can we address reading challenges and provide every student with the support he or she needs.

Understand the importance of the science of reading and learn how to impact the struggling reader.

Free Science of Reading eBook

that "decodable" books, designed to help students practice specific letter-sound combinations, can benefit the earliest readers. But it is mixed, and students very quickly progress enough to get more benefit from texts that provide more complex and irregular words—and often texts that students find more interesting.

How much time should teachers spend on teaching about letters and sounds in class?

There isn't yet a definitive "best" amount of time to spend on phonics instruction. In several meta-analyses, researchers haven't found a direct link between program length and effectiveness.

The National Reading Panel report found that programs focusing on phonemic awareness, the ability to hear, identify, and manipulate the smallest units of speech sounds, that lasted less than 20 hours total had the greatest effect on reading skills. Across the studies that the researchers looked at, individual sessions lasted 25 minutes on average.

But the authors of the NRP are quick to point out that these patterns are descriptive, not prescriptive. The studies they looked at weren't specifically testing the effectiveness of different time lengths, and it may be that time wasn't the relevant factor in these shorter programs performing better.

Eventually, a skilled reader doesn't need to sound out every word that she reads. She sees the word and recognizes it immediately. Through reading the word again and again over time, her brain has linked this particular sequence to this word, through a process called orthographic mapping.

But neuroscience research has shown that even if it feels like she's recognizing the word as a whole, she's still attending to the sequence of individual letters in the word for an incredibly short period of time. That's how skilled readers can tell the difference between the words "accent" and "ascent."

What else—aside from phonics—is part of a research-based early reading program?

Phonics is essential to a research-based reading program. If students can't decode words, they can't derive any meaning from them. But understanding the alphabetic code doesn't automatically make students good readers. There are five essential components of reading: phonemic awareness, phonics, fluency, vocabulary, and comprehension.

"Phonics is essential to a research-based reading program. If students can't decode words, they can't derive any meaning from them. But understanding the alphabetic code doesn't automatically make students good readers."

The National Reading Panel addressed all five of these components. The researchers found that having students read out loud with guidance and feedback improved reading fluency. Vocabulary instruction, both explicit and implicit, led to better reading comprehension—and it was most effective when students had multiple opportunities to see and use new words in context. They also found that teaching comprehension strategies can also lead to gains in reading achievement, though most of these studies were done with students older than 2nd grade.

For younger students, oral language skills; understanding syntax, grammar, vocabulary, and idioms; and having general and topic-specific background knowledge are also essential for reading comprehension.

This is one of the premises of the Simple View of Reading, a framework to understand reading first proposed by researchers Philip B. Gough and William E. Tunmer in 1986. In the simple view, reading comprehension is the product of decoding ability and language comprehension. If a student can't decode, it doesn't matter how much background knowledge and vocabulary he understands—he won't be able to understand what's on the page. But the opposite is also true: If a student can decode but doesn't have a deep enough understanding of oral language, he won't be able to understand the words he can say out loud. Since Gough and Tunmer first proposed this framework, many studies have confirmed its basic structure—that comprehension and decoding are separate processes. One meta-analysis of reading intervention studies finds that phonics-focused interventions were most effective through grade 1; in older grades—when most students will have mastered phonics—interventions that targeted comprehension or a mix of reading skills showed bigger effects on students' reading skills.

For young students, early oral-language interventions can help set them up for success even before they start formal school.

The National Early Literacy Panel found that both reading books to young children and engaging in activities aimed at improving their language development improved their oral language skills.

If children don't learn to read naturally from being exposed to reading, why are parents and teachers encouraged to read to infants and preschoolers?

The amount of time adults read with preschoolers and young children does predict their reading skills in elementary school. One of the most important predictors of how well a child will learn to read is the size and quality of his spoken language and vocabulary, and children are more likely to be exposed to new words and their meanings or pick up grammar rules from reading aloud with adults.

In a series of studies in the late 1990s of 5-year-olds who had not yet learned to read, Victoria Purcell-Gates found that after controlling for the income and education level of the children's parents, children who had been read to regularly in the last two years used more "literary" language, longer phrases, and more sophisticated sentence structures. Moreover, an adult reading with a child is more likely to explain or expand on the meanings of words and concepts that the child does not already know, adding to their background knowledge.

Reading with trusted adults also helps children develop a love of reading. "The association between hearing written language and feeling loved provides the best foundation for this long process [of emergent literacy], and no cognitive scientist or educational researcher could have designed a better one," notes cognitive neuroscientist Maryanne Wolf.

What about independent choice reading?

In a choice reading period—also known as sustained silent reading or Drop Everything and Read—students get to pick a book to read independently in class for a set amount of time. The premise behind this activity is that children need time to practice reading skills on their own to improve.

There is a lot of correlational research that shows that children who read more are better readers. But many of these studies don't quantify how much reading students are actually doing. While they may specify a time frame—15 minutes of sustained silent reading, for example—the studies don't report whether kids spend this time reading. That makes it difficult to know how effective choice reading actually is.

More importantly, these studies don't provide experimental evidence—it's not clear whether reading more is what makes students better readers, or if better readers are likely to read more. The National Reading Panel found that there wasn't evidence that choice reading improved students' fluency.

Does it make a difference whether children learn to read using printed books or digital ones?

In the last decade or so, access to Internet-based text has continued to expand, and schools have increasingly used digitally based books, particularly to support students who do not have easy access to paper books at home. Yet some emerging evidence suggests children learn to read differently in print versus digitally, in ways that could hinder their later comprehension.

Researchers that study eye movements find that those reading digital text are more likely to skim or read nonlinearly, looking for key words to give the gist, jump to the end to find conclusions or takeaways, and only sometimes go back to find context in the rest of the text. In a separate series of studies since 2015, researchers led by Anne Mangen found that students who read short stories and especially longer texts in a print format were better able to remember the plot and sequence of events than those who read the same text on a screen.

It's not yet clear how universal these changes are, but teachers may want to keep watch on how well their students reading electronically are developing deeper reading and comprehension skills. ■

Article annotations are available.

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Published March 23, 2021

Most States Fail to Measure Teachers' Knowledge of the 'Science of Reading,' Report Says

By Sarah Schwartz

For many elementary school teachers, teaching students how to read is a central part of the job. But the majority of states don't evaluate whether prospective teachers have the knowledge they'll need to teach reading effectively before granting them certification, according to a new analysis from the National Council on Teacher Quality.

According to NCTQ's evaluation of state licensure tests for teachers, 20 states use assessments that fully measure candidates' knowledge of the "science of reading," referencing the body of research on the most effective methods for teaching young children how to decode text, read fluently, and understand what they're reading.

For special education teachers, a group that regularly works with students with reading difficulties, just 11 states' certification tests meet this standard.

Previous studies have shown that early elementary teachers often have gaps in their knowledge of evidence-based practices for teaching reading, and that many teacher-preparation programs that don't adequately cover this topic. Some preparation programs introduce strategies that aren't supported by research.

A 2019 Education Week Research Center survey of K-2 and special education teachers found that only 11 percent said they felt "completely prepared" to teach early reading when they finished their preservice programs.

By NCTQ's assessment, 32 states require elementary preparation programs to address the five components of reading, as defined by the National Reading Panel report released in 2000—phonemic awareness, phonics, fluency, vocabulary, and comprehension.

Ensuring that teachers are prepared to teach reading before they enter the classroom, and incentivizing preparation programs to provide that training, will be especially important over the next few years, said Kate Walsh, the president of NCTQ.

"In normal years, we know about a million 4th graders haven't learned how to read," Walsh said, referencing results from the 2019 National Assessment of Educational Progress that categorize only 35 percent of 4th graders as proficient in reading. It's possible that the pandemic will leave students with more ground to make up, she said.

Can changes to licensure tests lead to better reading instruction?

For this analysis, NCTQ looked at content outlines, test objectives, and test prep materials for the state licensure tests given to elementary, early education, and special education teacher candidates—the three groups that are most likely to be responsible for foundational reading instruction.

The organization based its evaluation of the tests on two guiding questions: 1) whether the tests addressed each of the five components of reading, and 2) whether they assessed students on any practices that aren't supported by evidence, like three-cueing—a method that teaches students they don't need to rely on decoding alone to figure out what a word says, but can also make guesses based on pictures and syntax. (Three-cueing can lessen the chances that students will use their understanding of letter sounds to read through words part-by-part, taking away an opportunity for students to practice their decoding skills and making it less likely that they'll recognize the word quickly the next time that they see it.)

Many of the tests that didn't meet NCTQ's criteria paid little attention to two important components of foundational skills instruction, Walsh said: phonemic awareness (the understanding that spoken words are made up of individual sounds) and phonics (how those individual sounds are represented by letters). These two skills are building blocks to fluent reading, and without them, some students will continue to struggle with reading into higher grades.

Walsh would want to see more states start giving tests that fully assess teachers' knowledge of the five components of reading. Giving these tests, and holding preparation programs accountable for students' first-time pass rate, would incentivize preservice programs to devote real resources to teaching these skills, she said.

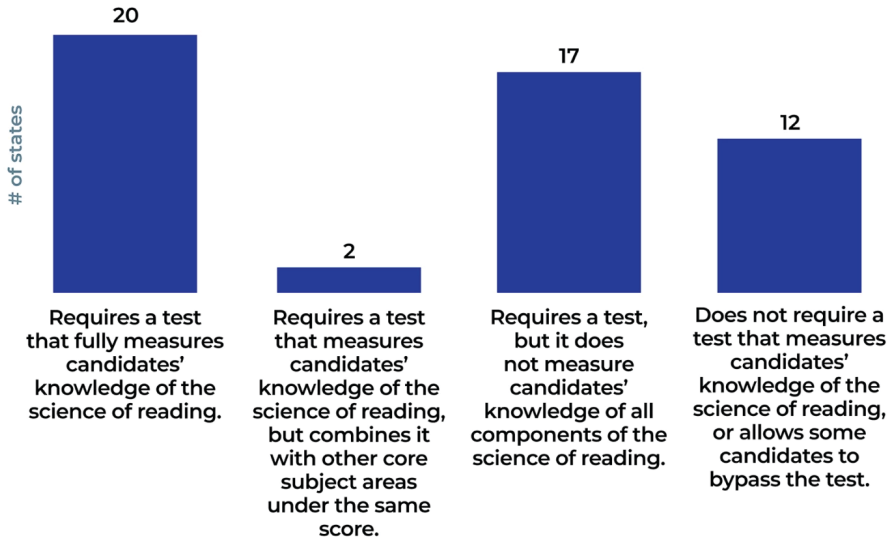
Still, some education professors don't place much emphasis on teaching candidates how to do explicit, systematic phonics instruction, and resist what they often call a "one-size-fits-all" approach, as Madeline Will reported in 2019.

Another hurdle, Walsh said, is that some states are also wary of adding more or tougher assessments to teacher candidates' plates.

In some cases, reading instruction tests are the only barrier between teacher candidates and certification. In California, for example, one-third of prospective teachers fail the first time they take the Reading Instruction Competence Assessment, or RICA, as EdSource reported in 2019. First-time failure rates are higher for Black and Latino candidates, and opponents of the assessment have argued that it's racially biased. (The majority of teachers of all races pass after multiple attempts.) The state has assembled a panel to recommend alternatives to the test.

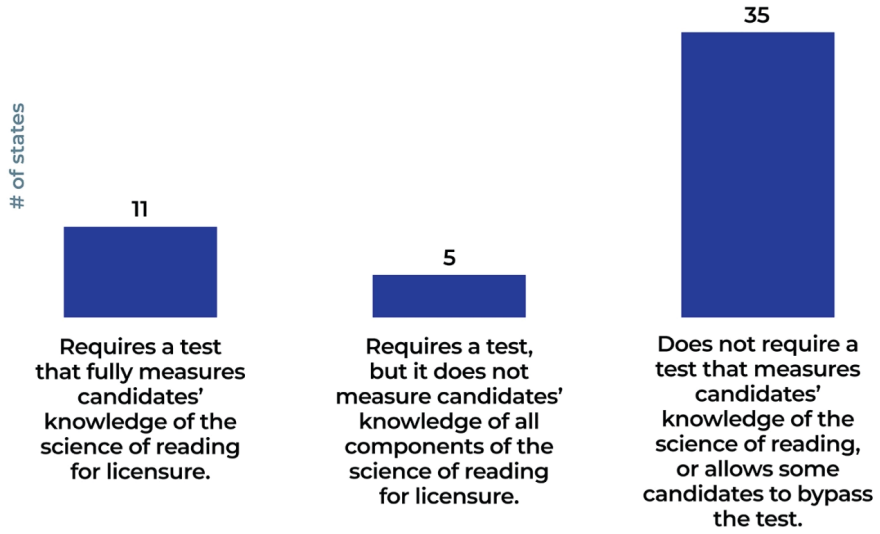
In general, "it's reasonable to say that teachers need to know certain things before they get classroom responsibilities of their own," said Dan Goldhaber, the director of the Center for Analysis of Longitudinal Data in Education Research at the American Insti-

State Licensure Test Requirements for Elementary Teachers on the Science of Reading



SOURCE: National Council on Teacher Quality

State Licensure Test Requirements for Special Education Teachers on the Science of Reading



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(logically ordered skills; simple to complex)

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tutes for Research and an expert in teacher certification, who wasn't involved with the NCTQ study. Even so, he says, any time certification tests show disparate impact on different populations of teacher candidates, it raises concerns.

It's up to professors of teacher education, and preservice programs more broadly, to make sure that what they're teaching is aligned to what states expect candidates to know, said Travis J. Bristol, an assistant professor at the University of California, Berkeley's Graduate School of Education, who studies teachers' workplace experiences.

"We're placing an undue burden on candidates of color when the preparation programs aren't giving students the necessary skills to pass this exam, and so these teacher candidates of color are now having to do extra work," he said.

States should also be considering whether a paper and pencil test is the best way to determine how prepared preservice educators are, and whether a performance-based assessment might be a better demonstration of candidates' skills, Bristol said. "There is evidence that people of color across all standardized exams do not pass them at the rate of their white peers," he said. "I think what we have to ask ourselves is, is that the right way to determine proficiency?"

Teacher preparation programs could set a higher bar for early reading instruction, Goldhaber said, a change that would be "at least as important" as stricter testing requirements in supporting teacher knowledge and effective instruction.

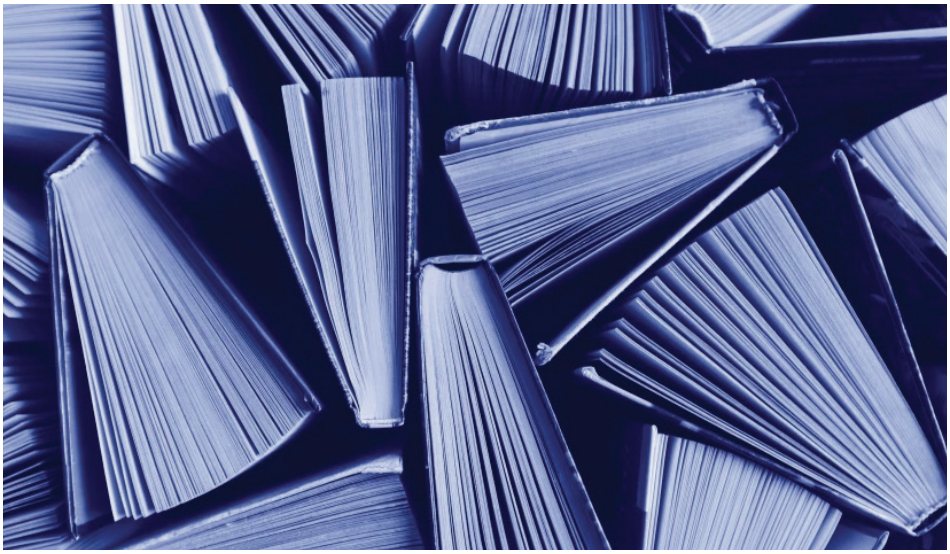
"What programs do or don't do to try to develop teacher candidates, and teach them how to teach, is really important," he said. "And it's that part of the system that I think we know very little about." ■

OPINION

Published May 29, 2019

The Hard Part About Reading Instruction

By Jared Myracle



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Spoiler alert: The hard part about reading instruction is not figuring out how to teach reading. We actually know quite a bit about that. There has been renewed interest in discussing the findings of the 2000 National Reading Panel report on the importance of phonics-based instruction in the early grades. The popularity of Emily Hanford's radio documentary "Hard Words" and Susan Pimentel's Education Week Commentary "Why Doesn't Every Teacher Know the Research on Reading Instruction?"—and the conversations both stirred—underscore that how we teach reading is far from settled, even 20 years after the publication of the panel's report. Earlier this year, I co-authored a Commentary in this publication on the challenges we district leaders face when it comes to the research-based findings on reading instruction. We all have unfinished learning, but the research is clear. Reading isn't just about decoding words.

Another critical element here is the central role that background knowledge plays in reading comprehension, which was demonstrated as early as 1988 by Lauren Leslie and Donna R. Recht's seminal baseball study: If we want students to actually understand the words they are decoding, they must build a critical mass of background knowledge in order to provide context and meaning to what they are reading.

The hard part about reading instruction isn't even deciding how to take action. Putting the research about reading instruction into practice has been simplified in recent years by the abundance of research-aligned curricula. Finding a suitable curriculum is now as easy as scrolling through EdReports.org and reading summaries of the "all green" options that signify positive standards alignment, usability, and quality. In my school district in Tennessee, we provided teachers with a few curricula options from this list, gathered feedback during a pilot period, and made a decision about what to use.

The hard part is not about the funding required to make these changes, either. On average, my district spent approximately $50 per student to replace all of our English/language arts curricula in every grade, kindergarten through 12th.

For school and district leaders, the hard part about reading instruction is leading a highly effective implementation and sticking to the plan long enough for the work to have a meaningful impact. Putting a new curriculum in a teacher's hand won't get the job done. They need support in order to teach it well. Teachers also need time to learn how to com-

municate the material effectively to students, and students need time to develop academically while learning it. But "time" is not a welcomed word in education.

The good news is that students respond quickly when teachers deliver systematic phonics instruction. Students in the early grades can more readily recognize letters and letter sounds, segmenting, and blending if they are receiving systematic phonics instruction. (David Liben's "Why a Structured Phonics Program is Effective" is a great summary on this topic.)

In my district's first year of implementation with our chosen curriculum (Core Knowledge's Skills Strand), we doubled the number of kindergarten students who scored above average on a phonics screener. This progress was mirrored by significant gains in the oral reading fluency of our 1st graders. Great instruction with strong materials can close skills gaps for our youngest students in a relatively short amount of time.

While students are making strides with their decoding skills, they must also be building the background knowledge on a wide array of topics needed to understand what they read. Instead of learning to read and then reading to learn, students can and should do both at the same time.

Many of the best curriculum options are structured this way. Embedding important historical figures and events, science concepts, exposure to a diverse array of cultures, and well-known fables and folktales in a coherent sequence within individual grades and across grade levels allows students to gradually connect meaning to otherwise unfamiliar topics as they read. But the key word here is "gradually."

Vocabulary is like a tiny snowball at the top of a hill. If you can guide it down the right path, it will gradually grow bigger on its own. It just takes a plan and patience.

As a leader, developing this kind of vision for reading instruction requires the constant switching between a long-term and a short-term view. Seeing gains in foundational reading skills happens early and often. On the other hand, navigating a multi-year process of building students' background knowledge is a more demanding journey. But the sooner we can all agree that there isn't a bright and shiny program that will save us tomorrow, the sooner we can do right by our students by focusing on what will have the biggest impact in the long run.

If you pursue this course of action, your 3rd grade reading scores will be great, right? Maybe. It is possible to see signs of progress. After a year, the state of Tennessee defined the growth of our district's 3rd grade students as "above expectations." But deeper reading proficiency improves at a slow pace.

The knowledge-building required to turn proficient decoders into proficient readers is a long haul, especially for students living in poverty. Comprehension is dependent on understanding the vocabulary involved in any given reading topic, but the topics on high-stakes reading assessments rarely align with the exact topics that students read about in the classroom.

So how do we fix it? We rely on the research about systematic phonics instruction, and we keep students reading books, articles, and literature embedded in a coherent path of topics designed to build their background knowledge. It can be frustrating that there is no way to fast track knowledge-building. You just have to trust the process, and take it day by day.

The education field is notorious for giving up when the results aren't immediate. But we should stick it out on this one and listen to the research on reading instruction. The rewards will come. ■

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