

Misunderstandings of the Science of Reading

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The science of reading movement has invigorated educators' interest in evidence-based practices for teaching reading (www.thereadingleague.org/what-is-the-science-of-reading). Spurred by dissatisfaction with stagnant test scores and provocative articles in the popular media, the science of reading movement has led many teachers to question the validity of their practices and seek evidence-based programs. As important as it is to identify and implement effective instructional practices, it is just as important to recognize and clarify misunderstandings about the science of reading. The science of reading has become a significant movement that has influenced changes to state legislation, state and school standards for curriculum approval and adoption, school instructional guidelines, and educators' professional development. In turn, these changes directly influence curriculum publishers who, to keep pace with market demands and be included in state-approved curricula lists, revise their programs to align with what the market wants.

Misperceptions about which practices are and are not evidence-based can result in programs and practices without research support being mandated and codified into curricula and instructional practice. Similarly, these misperceptions can lead to the unnecessary abandonment of practices or materials that are incorrectly perceived as being inconsistent with the science of reading. Ultimately, these misunderstandings can negatively impact students, educators, and families. As reading researchers, we are concerned that these misunderstandings will undermine the influence of scientific findings in the future. Why should educators continue to trust scientific findings if previous ones were interpreted carelessly? Why should educators trust future pushes to implement "scientific findings from education research" when there are multiple ways to interpret it, and the changes require so much effort? Movements like what has occurred with the science of reading can result in a belief that a consensus exists on what constitutes effective reading instruction, and any skepticism or questions to the contrary are discouraged. Social media offers a platform for perspectives and opinions to spread rapidly, and when expressed by influential members of a group, become accepted even faster. In reality, however, some aspects of what becomes accepted as best practice actually lack empirical support, either because research findings are equivocal or simply because they have never been studied experimentally.

To clarify what we know and don't know about the science of reading, we respond to

the following list of common misunderstandings we have observed and questions that have been asked as part of the science of reading movement.

1. Does the science of reading refer to a program or specific pedagogy?

The science of reading movement has motivated many teachers and schools to change how they teach reading—so much so that many have declared they are a "science of reading district," a "science of reading school," or that they are now "doing the science of reading." Effective reading instruction is based on the science of reading. However, the science of reading is not a program or pedagogy that can be purchased or adopted. Some programs are better aligned with the science of reading, but there are not "science of reading programs." A problem with referring to the science of reading as a package or specific pedagogy is that if student reading achievement is slow to improve after a school "adopts" the science of reading, it makes it easy to place blame and create narratives, such as "we tried the science of reading, and it didn't work."

Like most areas of scientific inquiry, the science of reading involves at least as many unanswered questions as there are evidence-based practices. When teachers are armed with the knowledge and understanding of how skilled reading develops, are aware of approaches and strategies supported by evidence, and have access to curriculum aligned with the science of reading, they are better equipped to meet the needs of their students.

2. Is learning to read a natural process?

Fundamental to the science of reading is that learning to read does not occur by simply being exposed to reading. The understanding that the development of reading is substantially different from acquiring oral language is a central premise that has differentiated advocates of the science of reading from other literacy professionals. Why does this matter? It matters because learning language is a natural process and will occur for the vast majority of youngsters through adequate exposure to models (typically parents) who speak to them and answer them as they begin to speak. However, this process of exposure and modeling does not have the same effect when learning to read because our brains are not naturally wired for reading like they are for oral language. For the majority of students, the most successful approaches to reading instruction involve explicit, systematic, and cumulative instruction in the alphabetic code (how sounds of language map to print) and how to use that code to read words; teaching what words mean and how to understand the language used in print; and providing abundant opportunities to read and understand increasingly complex texts with direct support and feedback from the teacher.

3. Won't all children learn to read if we wait long enough?

Learning to read is much easier for some students than others, but it is not an automatic process. As with all learning, students acquire proficiency at varying rates and with varying amounts of effort. Teaching all students appropriately with explicit instruction provides them with faster access to reading with significantly less stress.

4. Has the science of reading established that there is only one effective way to teach reading?

This is a misunderstanding of the science of reading that often pairs with the idea that the only effective approaches have specific names or descriptors, such as "multisensory" or "Structured Literacy." Any claims that specific approaches or programs are the only way to support students' acquisition of reading skills are faulty. Also, individuals who make claims about specific scope and sequences of reading instruction are often extending what we know about the science of reading inappropriately. For example, we have little evidence about which vowel digraphs (e.g., *ea* or *ou*) should be taught first.

As previously described, for most students, a well-organized approach to reading instruc-

tion that includes learning the alphabetic principle (how sounds of language map to print), learning to decode words, learning their meanings, and having supported access to increasingly complex text types is essential for learning to read and learning from text. Within this framework, there are many effective ways to teach students to read that align with the science of reading.

We think it is also valuable to acknowledge here that there is a need to think about how we differentiate instruction for the range of learners. Adopting a set of explicit and deliberate instructional practices and a better set of curricular materials will not automatically ensure that all students benefit from instruction if teachers are not knowledgeable about practices for differentiating instruction for students with varying needs.

5. Does the science of reading show that most reading instruction should be focused on phonics?

The following are some reasons why phonics dominates conversations about the science of reading:

- Providing phonics instruction has been controversial for decades and yet it is consistently associated with improved outcomes in beginning reading.
- Many teachers are unprepared to teach phonics and so prefer not to.
- Phonics is often neglected or minimized within the way most teachers have implemented a "balanced" approach to literacy.

Decades of research have demonstrated that phonics instruction supports acquisition to reading for most children. However, the importance of teaching phonics does not mean that reading instruction should be solely devoted to it or even that phonics instruction should consume the majority of time dedicated to reading lessons. It is possible that curriculum developers, in responding to perceived market demand and state legislation for designing lists of approved reading programs, will develop or revise reading programs in which phonics instruction is increased to the point that it makes up the majority of the daily reading lessons, thus sacrificing time from other critical areas of instruction such as vocabulary, background knowledge, and opportunities for reading practice. Furthermore, appropriate instruction in phonics is not a replacement for all of the ways in which we promote language development for developing readers, including read-aloud books and promoting language and discourse about reading (aloud and independently).

6. Does the science of reading say that pictures should never be used in reading instruction?

Referring to pictures and illustrations as clues to words' pronunciations is one element of the highly problematic three-cueing approach to teaching. However, the notion that pictures or illustrations should *never* be used in reading instruction is an overstep. Effective reading instruction provides practices that promote students' use of the knowledge of the alphabetic principle to read words. However, pictures can be useful to engage students in the story and encourage them to consider their own pictures in their heads while they read. Illustrations can be used to help students verify their understanding and can help build and expand comprehension. They can serve as a catalyst for the teacher to ask additional questions, make inferences, or prompt additional discussion about the events in the text and the connection to knowledge and feelings. The purpose of pictures is to captivate readers, engage them, and help them visualize elements of the story. Many advocates of the science of reading who argue to *never* use illustrations in reading instruction are often not aware of the series of seminal studies in which a first-grade intervention program made use of pictures and sentence context for comprehension in addition to alphabetic-based instruction (Scanlon & Vellutino, 1996, 1997; Vellutino & Scanlon, 2002; Vellutino et al., 2000).

7. What is the role of comprehension in the science of reading?

The purpose of learning to read is to understand and learn from text. Comprehension is the expected outcome from reading, and practices that enhance students' success with comprehension are an essential feature of implementing the science of reading. Why, then, is comprehension so rarely the focus of discourse and debate around the science of reading? The answer is likely because practices that help students build foundational skills for word reading—phonemic awareness and phonics—have been missing from effective reading instruction. There has been no argument about whether comprehension is a feature of reading because there is no disagreement that comprehension is the goal. Yet, there has been considerable disagreement about whether phonemic awareness and phonics, for example, should be features of reading instruction. As scholars have clarified (e.g., Castles et al., 2018; Petscher et al., 2020; Solari et al., 2020), the reading wars,

at the most basic level, have largely been about our approach to teaching students how to read words.

8. Does the science of reading say that decodable texts are a necessary part of instruction?

Text that is considered "decodable" is written to include a high proportion of words that are phonetically regular and/or contain phonetic elements that have been taught. Therefore, most of the words in the text can be sounded out, given students' prior instruction. In contrast, authentic text is text written without constraints on the phonetic regularity or specific spelling patterns of the words. There is little evidence to suggest that using decodable text is superior to using authentic text. A quasi-experimental study (Blevins, 2019) observed some benefit of using decodable texts; however, other experimental studies have not revealed a benefit of using decodable text compared to authentic text (Jenkins et al. 2004; Price-Mohr & Price, 2019). Contrary to what some have claimed, the science of reading does not yet say that decodable texts are a necessary part of reading instruction.

However, this does not mean that decodable texts should be avoided. We suggest that when used strategically and judiciously, decodable texts provide a scaffold to make texts accessible for practicing new decoding skills in connected text. Decodable texts are most applicable for use with beginning readers. But, like any scaffold, decodable text is not meant to be a permanent fixture in instruction. From the beginning stages of learning to read, providing students with multiple text types with adequate support enhances their generalization of reading principles. After students acquire decoding skills, authentic texts provide an opportunity to extend their knowledge to more challenging texts. Authentic texts are valuable additions to instruction as they expose students to more diverse vocabulary, syntax, and background knowledge than they encounter in decodable text. Even beginning readers should be provided with opportunities to read authentic text at an appropriate level, and as their skills improve, decodable text would be used increasingly less often until authentic text is used exclusively.

9. Does the science of reading say that "leveled texts" should never be used?

In the popular science of reading discourse, "leveled text" has become a taboo term given its association with programs and practices that emphasize identifying a student's reading

“level” and using that to prescribe instruction. However, the text itself within leveled texts was not necessarily the problem; the problem is how these levels and leveled texts are used. Recently, we have heard anecdotal reports of schools throwing away their sets of leveled texts as they try to align their practices with the science of reading, which, in our opinion, is a waste of a potentially valuable source of content for reading practice.

Students benefit from structured opportunities to read a variety of text types across a range of levels. Leveled texts may be considered one of the many types of texts (e.g., information, narrative, hybrid) that students have access to when developing reading proficiency. As long as they are not “predictable” texts (e.g., students are reading texts in which the pattern of words is predictable—thus, not requiring students to actually know how to read all of the words), there is nothing inherently wrong with texts that have had levels assigned or that come from a leveled series. Many of the texts in these series cover a broad range of genres and subjects, which allows for greater flexibility in identifying text on a particular topic or aligned with students’ interests. There is also value in providing students with content that, depending on their reading skills and the level of teacher support available, they would be successful in reading or even somewhat challenged (i.e., “stretch” text). Extensive opportunities for students to read a range of texts with support from a skilled reader can provide valuable practice.

10. Will 95% of all students learn to read if provided instruction aligned with the science of reading?

There is little evidence to support the notion that 95% of all students can read proficiently if provided instruction consistent with the science of reading. We are not certain where this idea was derived, but it may have come from the No Child Left Behind legislation (January 8, 2002). However, it is likely that 95% of students would have *improved* reading outcomes if educators had the resources, skills, and time to provide effective reading instruction. We can certainly do a lot better than we are currently doing, but a goal of reaching 95% of all students reading on grade level is unlikely to be achieved.

11. Does the science of reading generalize to students who are English learners (ELs)?

Yes, the science of reading extends to students who are ELs and supports the acceleration of learning to read. In their summary of research,

Vargas and colleagues (2021) concluded that (a) models of reading development, such as the simple view of reading (Gough & Tunmer, 1986) also apply to ELs; (b) the skills that predict reading proficiency and risk of reading difficulties are the same for ELs and non-ELs; and (c) interventions aligned with the science of reading are similarly effective for ELs and non-ELs. Of course, ELs learning to read in English will often require additional support and instruction in oral language, but continuing to perpetuate the notion that ELs do not benefit from reading instruction aligned with the science of reading is harmful to many EL students (Cardenas-Hagan, 2020; Goldenberg, 2020).

12. Is the three-cueing system helpful for English language learners?

All students need to be able to read the words on the page, and the three-cueing system is ineffective for teaching students to read words. This is true for ELs as well.

13. Is the science of reading based solely on implementing whole class instruction?

Multiple grouping formats are associated with improved outcomes for learners. Students benefit when teachers align the grouping format with the learning goals. Grouping formats such as student pairs are often effective for fluency activities and other word reading practices. Small group instruction can be useful for teaching challenging skills to students who had difficulty during the whole class instruction or for supporting readers with opportunities to read and discuss common texts. There are many advantages to using the full array of grouping formats to support students learning to read.

14. Does the science of reading say that phonemic awareness should be taught “in the dark” (i.e., without print)?

Across the 1990s and 2000s, phonemic awareness was a new concept to many in reading research and instruction. During this time period, to aid in understanding, some described it as a skill that could be done “in the dark” or with one’s eyes closed. These expressions were used to illustrate that the skill itself involved being sensitive to the sound structure of language independent of print, but they were *not* suggesting it should be taught that way. Although there are situations in which phonemic awareness activities could be used in absence of print, such as in pre-K or early kindergarten before children have learned any letter sounds, comprehensive research reviews have indicated that reading outcomes are stronger when

phonemic awareness is integrated with letters and words (Bus & van IJzendoorn, 1999; National Reading Panel, 2000), and phonemic awareness instruction is less effective in promoting reading outcomes when it is done in absence of print (Steleaga et al., 2024).

As Beck (2009) wrote, "phonemic awareness may be taking on more of a life of its own than is useful" (p. 30). Since then, new legislation and standards in several states include recommendations to teach and/or assess phonemic awareness through upper elementary grades as though phonemic awareness itself has become a primary instructional target. Misunderstandings of the nature and role of phonemic awareness instruction have also given rise to programs and dedicated classroom time on phonemic awareness independent of print. Overall, it seems the "in the dark" expression has been misinterpreted as a recommendation on how it should be taught.

The single goal of reading instruction is *reading*. Phonemic awareness, particularly the ability to segment and blend phonemes, is indeed a key foundational skill in the development of reading skills. It helps children connect letters with sounds and enables them to segment and blend sounds as they read and spell words. A basic level of phonemic awareness helps beginning readers access the alphabetic code. However, phonemic awareness development becomes quickly intertwined with reading development as soon as students begin to learn letter sounds and how to decode. Good phonics instruction naturally integrates phonemic awareness with print, and research has yet to reveal a benefit of stand-alone oral phonemic awareness over print-based instruction. Coyne et al. (2021) found that, with first graders in core instruction, students who received stand-alone oral phonemic awareness instruction did not demonstrate stronger reading skills than students who did not receive such instruction. Evidence also indicates that print-based instruction is just as effective in targeting phonemic skills as stand-alone oral phonemic instruction, which was observed in a meta-analysis by Steleaga and colleagues (2024) that included students with and without reading difficulties. This effect was also the case for students with reading difficulties researched by McCandliss et al. (2004), who found that phonemic awareness skills, even advanced skills such as phoneme deletion, improved through code-based instruction without any isolated oral phonemic awareness training. Because reading is the goal, the optimal use of time to teach phonemic awareness is to uti-

lize letters as students learn to segment, blend, and manipulate sounds in words.

In sum, it is important to keep in mind what the National Reading Panel (2000) advised nearly 25 years ago:

Teachers should recognize that acquiring phonemic awareness is a means rather than an end. [Phonemic awareness] 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 [phonemic awareness] skills in reading and writing tasks. (p. 2-6)

15. According to the science of reading, is a "speech-to-print" approach to beginning reading instruction superior to a "print-to-speech" approach?

A primary objective of beginning reading instruction is teaching letter-sound correspondences. Traditionally, letter sounds have been taught via what has more recently been referred to as a print-to-speech approach, in which instruction targets a particular letter (or a letter combination) and the sound it typically makes. In contrast, a speech-to-print approach focuses on a specific phoneme and teaches the letters and letter combinations that can represent that sound. Support in such instruction involves the creation of classroom "sound walls" in which phonemes are connected with the letters and letter combinations that can make each sound. A speech-to-print approach recommends extensive instruction and practice in spelling, in which students are taught to identify sounds they hear in spoken words and represent them with letters.

To date, no studies have tested whether a speech-to-print approach is superior to any other type of instruction. The theoretical basis for the speech-to-print approach suggests that it is better because children enter reading instruction with access to a rich, organized set of speech sounds, which provides a simpler basis for teaching children to connect letters and letter units with each sound. However, one could also argue the opposite. Phonemes are an abstract concept, especially for 5-year-olds, and teaching multiple letters and letter units that link to already abstract information introduces significant cognitive load demands for children this age. In contrast, a print-to-speech approach may make learning and applying the

alphabetic principle more accessible by teaching a concrete unit, a letter, and the sound(s) it makes. Scholars have suggested that learning about letters helps children refine their perception of speech sounds to the phoneme level (e.g., Foulín, 2005).

Additionally, although we advocate for greater integration of spelling instruction within reading instruction, and evidence indicates that spelling instruction benefits reading skills (Chandler et al., 2024; Graham & Santangelo, 2014), we caution that spelling activities can be taken too far. Spelling a word will almost always take longer than reading it, especially for kindergarteners with developing graphomotor skills. Children could read numerous words in the time it takes to write just one. Clearly, research is needed on whether a speech-to-print approach is superior to print-to-speech. Consider that an ideal approach would incorporate elements of both.

16. According to the science of reading, is it necessary for students to learn spelling and syllable division rules?

A long-standing characteristic of some forms of reading instruction emphasizes teaching students spelling “rules” and syllable division patterns, with the idea that memorizing these rules helps students read and spell words they have not previously encountered. Reading research has never established that learning these rules is necessary for learning to read well; in fact, approaches that emphasize these techniques were developed long before much reading research existed. Scholars have also noted the inconsistency of spelling and syllable rules in English (e.g., Johnston, 2001; Kearns, 2020).

Our perspective should in no way be construed as a discouragement of phonics instruction. We agree with Duke (2014) that the research evidence points to the importance of teaching letter-sound relationships for letters and letter combinations (of which there is far more consistency in English when compared to the rules), reading phonograms and rimes, exposing students to exception pronunciations of letters and combinations (especially vowel sounds), and perhaps most important, teaching students to be flexible and adjust pronunciations when needed.

17. Does the science of reading say that reading pseudowords (i.e., “nonsense” words) is a key part of phonics instruction?

Pseudoword reading can be useful for assessment, particularly when one is interested in how well students can apply their knowledge

of letter sounds and spelling patterns to words they have never seen. However, recommendations to include pseudowords in reading instruction should be considered very cautiously. We are unaware of studies evaluating whether pseudoword reading instruction or practice is beneficial for students’ reading acquisition. We are aware that students with dyslexia differ from typical readers in both underdeveloped phonemic awareness and pseudoword reading (Grainger et al., 2003); however, the specific benefits from extensively practicing pseudoword reading is undocumented. Studies have often noted that many forms of instruction and intervention show greater benefits (in some cases double the effect size) in improving students’ ability to read pseudowords compared to reading real words and text (Flynn et al., 2012; Scamacca et al., 2007; Stevens et al., 2021; Torgesen, 2006; Wanzek & Vaughn, 2007), which suggests that instruction that improves decoding phonetically-regular words is not necessarily going to have a similar effect on students’ ability to read overall.

If used sparingly, there may be situations in which pseudowords can be used as tools or scaffolds. Having students read pseudowords may be useful to encourage attention to letters for students who are prone to guessing at words based on word features (e.g., first letter or word shape) to match those in their oral vocabulary. Pseudowords can also provide opportunities to practice newly learned letter-sound patterns. However, reading real words is the central goal of instruction, and any instruction or practice with pseudowords should be brief. Some have argued that syllables within words are essentially pseudowords, and thus, there is value in teaching nonsense word reading to support reading multisyllabic words; however, we would argue it would be more efficient to teach students to read the actual syllables themselves. Pseudowords are not necessary to teach students to rely on the alphabetic code. In semi-regular orthographies like English, where exceptions to spelling-sound correspondences are common, instruction and practice in reading real words is essential.

18. Is the science of reading about teaching the “Big Five”?

The “Big Five” or “Five Pillars” or “Five Big Ideas of Reading” are terms that have been commonly used to refer to phonemic awareness, phonics, fluency, vocabulary, and comprehension. Many people incorrectly assume that the National Reading Panel (2000) identified the Big Five. In their research reviews, the panel inves-

tigated eight questions, five of which involved the extent to which instruction in phonemic awareness, phonics, fluency, vocabulary, and reading comprehension strategies improved reading outcomes. Instruction or practice in each area was found to improve reading skills. However, identifying all important elements of reading instruction was never a goal of the panel; they did not review all reading research to determine which aspects were most important, and they never once mentioned the “Big Five” or similar phrases.

Instead, the Big Five idea was the result of readers’ interpretation of the National Reading Panel report and messaging aimed at disseminating its key findings at a time when some of the elements (e.g., phonemic awareness) were not well known, and others were underappreciated or ignored (e.g., phonics) in Whole Language teaching approaches. Timothy Shanahan, a member of the National Reading Panel, noted that readers of the report tended to focus only on the five instructional topics investigated and often incorrectly inferred that the order in which they were presented in the report was a recommended sequence of how they should be taught or how instruction should be organized (Shanahan, 2005). Today, it is common to see the five elements referenced specifically in state legislation and standards about how reading instruction and assessments should be structured across grade levels. Some states have even gone so far as to specify the amount of minutes that should be spent on each of the five areas each day.

There is no question that the five elements are important parts of reading. However, problems arise when the Big Five are misinterpreted as a prescription for how instruction should be organized, how instructional time should be divided, or that instruction need not include other important elements such as background knowledge, spelling, and writing. It is also a problem if the Big Five notion is interpreted as instruction being isolated and specific (i.e., “siloe”) within each domain. For example, repeated reference to phonemic awareness as one of the Big Five may have helped pave the way for programs that targeted phonemic awareness in isolation from phonics.

Rather than thinking rigidly about the Big Five, we suggest implementing these elements in a more integrated and fluid way, with the integration of other elements such as background knowledge, spelling, and writing. High-quality phonics instruction, which inherently includes phonemic awareness skills and spelling instruction, would naturally be an area

of emphasis in kindergarten through second grade, but its emphasis and how it looks should change across middle and later elementary grades as students develop proficiency in code-related skills. Vocabulary is closely tied to background knowledge (i.e., having knowledge about a topic often depends on understanding the terms involved in that topic); both should be taught extensively throughout all grade levels, and what is taught should align with what students are expected to read. Providing supported opportunities for students to practice reading words and text every day supports the development of reading fluency and provides a context for teaching students to connect ideas and integrate their prior knowledge to better comprehend and write about what they read.

Conclusion

We imagine that the misunderstandings of the science of reading that we offer in this document may truly be only the tip of the iceberg of the many misunderstandings that are being promoted within the science of reading framework. We appreciate that in the vast majority of cases, individuals and organizations promoting these ideas are well-intentioned—hoping to rectify previous instructional casualties. What concerns us most is that these misunderstandings will be construed as research-based findings and that many states and school districts will implement them with what will likely be an unrealized hope of improving reading outcomes. In fact, we are aware that this is already the case.

So, what do we do now, and how do we rectify the false moves concerning the science of reading? First and foremost, we must focus on equipping teachers with the knowledge and skills they need to improve student reading outcomes. This will require far more than knowledge of how to teach phonics and phonemic awareness. Teachers also need to understand the value of deliberate practice (Vaughn & Fletcher, 2023), the science of learning and teaching, and have a more complete application and integration of what we know about how youngsters acquire proficiency in reading. Any prescribed standardization and over-mechanization of reading instruction for all students will never adequately meet the needs of each student—customization is necessary as learning is acquired differently by different students. Stating that “we are following the science of reading” will never replace the impact of well-educated and knowledgeable teachers who both understand the science of reading and the instructional practices that are most effective. ■

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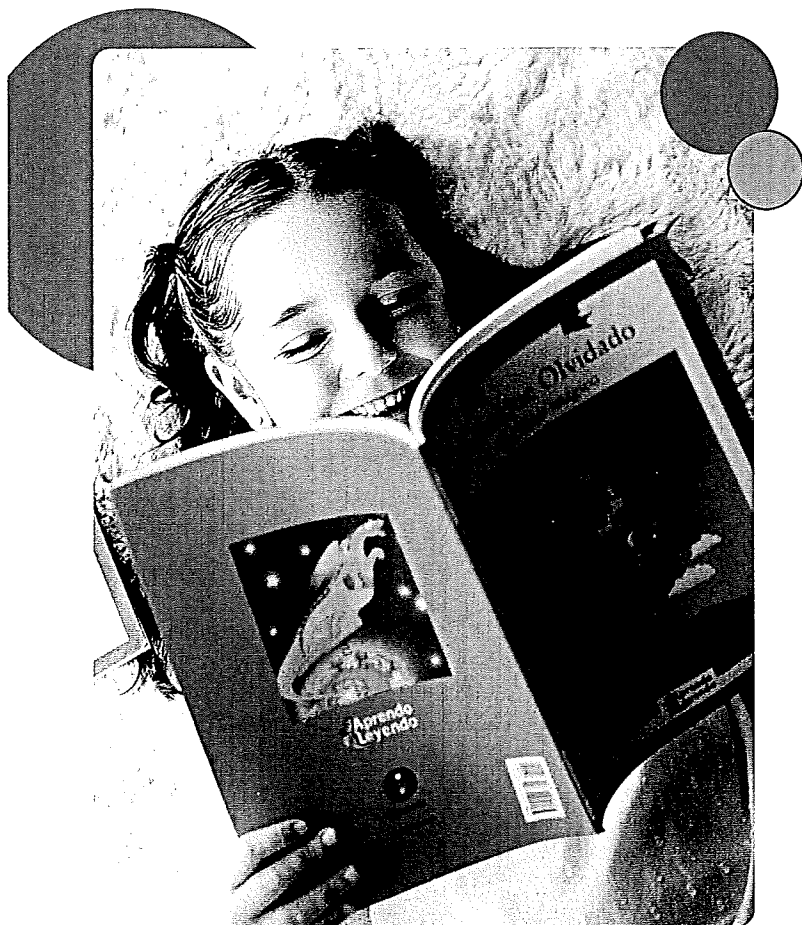
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Dr. Sharon Vaughn is the Manuel J. Justiz Endowed Chair in Education and the executive director of The Meadows Center for Preventing Educational Risk, an organized research unit that she founded with a "make a wish" gift from the Meadows Foundation family. She is the recipient of numerous awards including, the Distinguished Faculty and Research Award, the CEC Research Award, the AERA SIG Distinguished Researcher Award, and the Jeannette E. Fleischner Award. She is the author of more than 40 books and 350 research articles, six of which have met the What Works Clearinghouse Criteria for their intervention reports. More information about her work can be found at www.meadowscenter.org.



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