Reconciling the Science of Reading and Effective Instruction

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While the science of reading has focused educators on what the research evidence tells us is necessary for children to learn to read, confusion remains about how best to teach what the research tells us. If we start with the understanding grounded in the work of Gough and Tunmer, then add the Reading Rope by Dr. Hollis Scarborough and articulated most recently in thereadingleague.org "Defining Guide," [1] we have a great deal of clarity about what is essential. So how do we take this body of evidence and use it to understand how best to teach? Structured literacy [2] certainly provides guidance, and exemplars of instruction are clearly delineated in the publication by the Institute of Education Sciences (IES), *Integrating Reading Foundations: A Tool for College Instructors of Pre-service Teachers.*[3] However, we also should be looking to the body of knowledge about how students learn and the research on effective instruction. By joining the science of reading to the science of learning and the research on effective instruction, we can clear up confusion about effective practices and help educators become more discerning consumers of commercial curriculum.

1 (2021) *The science of reading: A defining guide.* https://www.thereadingleague.org/what-is-the-science-of-reading/defining-guide-ebook/

2 Spear-Swerling L. Structured Literacy and Typical Literacy Practices: Understanding Differences to Create Instructional Opportunities. *TEACHING Exceptional Children.* 2019;51(3):201-211. doi:10.1177/0040059917750160.

3 Dombek, J. L., Lee, L., Foorman, B., & Underwood, P. (2021). *Integrating reading foundations: A tool for college instructors of pre-service teachers* (REL 2021–060). U. S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Southeast. http://ies.ed.gov/ncee/edlabs. This resource is available on the Regional Educational Laboratory website at http://ies.ed.gov/ncee/edlabs.

SCIENCE OF READING

Most educators are now familiar with Gough and Tunmer's Simple View of Reading (Gough, P. B., & Tunmer, W. E. (1986), "Decoding, reading, and reading disability." *Remedial and Special Education*, 7, 6-10).[4] Their framework has been validated by over 150 scientific studies and makes clear that both decoding and language comprehension, working together in a multiplicative relationship, are necessary for reading comprehension. This relationship is depicted by a mathematical formula:

What is less well known is that in 1990, Wesley Hoover and Philip Gough further broke down decoding and language comprehension,[5] and even later, in 2019, William Tunmer and Wesley Hoover again clarified and substantiated the durability of the original framework.[6]

Meanwhile, completely independent of the work done by Gough, Tunmer, and Hoover, and as early as 1992, Dr. Hollis Scarborough was also developing a theoretical framework. Her framework that became known as the Reading Rope has often been mistakenly interpreted as providing a detailed graphic based on the original Gough and Tunmer Simple View of Reading. However, that is not the case as interviews with Dr. Scarborough confirm. Scarborough's reading rope graphic as a theoretical framework was printed in her 2001 article "Connecting early language and literacy to later reading (dis) abilities: Evidence, theory, and practice."[7] Dr. Scarborough's graphic shows the multifaceted nature of learning to read and the interactivity of word recognition and its underlying components and language comprehension and its underlying components. In 2000, the National Reading Panel's report summarized five critical components necessary to become a reader: phonemic awareness, phonics, fluency, vocabulary, and comprehension.[8] Still later, in 2016, the IES practice guide *Foundational Skills to Support Reading for Understanding in Kindergarten Through 3rd Grade* again reaffirmed these components.[9] Thus, a body of evidence, confirmed time and again in scientific studies conducted over 50 years in multiple fields of research, provides a solid basis for understanding what is necessary for children to become readers. Adding to this knowledge is an equally strong body of knowledge derived from cognitive science of how learning happens, referred to as the science of learning. The science of learning, when combined with the science of reading, not only further validates reading science but also provides greater clarity about effective instructional practices.

4 Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education*, 7, 6-10.
5 Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing: An Interdisciplinary Journal*, 2(2), 127–160. https://doi.org/10.1007/BF00401799.
6 William E. Tunmer & Wesley A. Hoover (2019) The cognitive foundations of learning to read: a framework for preventing and remediating reading difficulties, *Australian Journal of Learning Difficulties*, 24:1, 75-93, DOI: 10.1080/19404158.2019.1614081.
7 Scarborough, H. S. (2001). Connecting early language and literacy to later reading (dis)abilities: Evidence, theory, and practice. In S. Neuman & D. Dickinson (Eds.), *Handbook for research in early literacy* (pp. 97 -110): Guilford.
8 Eunice Kennedy Shriver National Institute of Child Health and Human Development, NIH, DHHS. (2000). *Report of the National Reading Panel: Teaching Children to Read: Reports of the Subgroups* (00-4754). Washington, DC: U.S. Government Printing Office.
9 Foorman, B., Beyler, N., Borradaile, K., Coyne, M., Denton, C. A., Dimino, J., Furgeson, J., Hayes, L., Henke, J., Justice, L., Keating, B., Lewis, W., Sattar, S., Streke, A., Wagner, R., & Wissel, S. (2016). *Foundational skills to support reading for understanding in kindergarten through 3rd grade* (NCEE 2016 -4008). Washington, DC: National Center for Education Evaluation and Regional Assistance (NCEE), Institute of Education Sciences, U.S. Department of Education. Retrieved from the NCEE website: http://whatworks.ed.gov.

SCIENCE OF LEARNING AND SCIENCE OF EARLY LEARNING

In 2015, Deans for Impact, an organization that started in 2014 as a group of deans of schools of education committed to improving teacher preparation, produced an important report, *The Science of Learning.*[10] This report was followed by another report in 2019, *The Science of Early Learning.*[11] Taken together, these two reports summarize the cognitive science about how children learn. The list below represents the most salient principles that relate to reading instruction from the science of early learning (marked early) and the science of learning in general (marked general):

- All writing systems use a visual code that children must crack (early)
- Sound-symbol relations need to be taught systematically and explicitly, moving from the simple to the complex (early)
- Children must develop phonemic awareness along with understanding how the sounds connect to the print (early)
- Systematic phonics has been shown to be the most effective way to teach the sound-symbol relationship (early)
- During phonics instruction, students should read and write the spellings for the sounds and read and write words to connect the sounds to the spellings (early)
- The most common words with complex or irregular spelling patterns should be taught explicitly (early)
- Children must develop concepts of print, and adults must support this development by calling explicit attention to direction of print and words in text to words spoken (early)
- Lots of practice with words and with connected text is necessary to develop automaticity and fluency, which in turn supports a focus on comprehension by reducing the memory load (early)
- Children need to develop morphological awareness as they develop as readers to connect meanings to patterns (early)
- Developing intrinsic motivation rather than extrinsic motivation will sustain children in the long run, and this requires ample books and texts in school and the home, but "independent reading time should not supplant other reading instruction. School time should be used for explicit instruction or guided practice."[12] (early)
- Reading aloud to young children is most effective to develop vocabulary, conceptual understanding, and text structure but must be interactive and include questioning, predicting, and analyzing (early)
- Children will develop understanding by reading texts that are content rich, varied by subject and culture (early)
- Reading a range of materials organized by topics creates a connected web of background knowledge, vocabulary, and facts (early)

10 Deans for Impact (2015). *The Science of Learning*. Austin, TX: Deans for Impact.
11 Deans for Impact (2019). *The Science of Early Learning*. Austin, TX: Deans for Impact.
12 National Institute of Child Health and Human Development (NICHD), 2000.

- Explicit comprehension strategies instruction will support young children in understanding texts but "alone cannot compensate for lack of vocabulary or content knowledge"[13] (early)[14]
- To learn, children need to transfer information from working to long-term memory; this requires not overwhelming learners with too much new information at once (general)
- Mnemonics are particularly useful to help students remember newly taught and hard-to-remember information (general)
- Practice is essential to learning new information and needs to be spaced with prior information interleaved with new information (general)
- Clear and specific feedback that focuses on the task and ways to improve is essential to acquiring new skills and knowledge (general)

This is a long list to be sure; however, the link between the science of reading and the science of learning is evident, and now we have some guiding principles for improved practice. First, the science of learning and the science of early learning confirm the importance of systematic and explicit instruction that moves incrementally in developing the alphabetic principle. It reminds us that ample practice is necessary and that practice decoding words and reading connected text are both necessary. It confirms the importance of fluency to free cognitive resources to make meaning, and it verifies the need to build background knowledge and vocabulary. It assures us of the need to provide ways for students to remember new information and the valuable contribution of feedback. These principles can help educators when they evaluate curriculum. We can think of these as design principles that ideally would be baked into commercial curriculum materials. Many of these principles also confirm what Barak Rosenshine found in his review of principles for instruction.

13 Castles, Rastle, & Nation, 2018; Willingham, 2006b; Willingham, 2006a.
14 Castles, A., Rastle, K., & Nation, K. (2018). Ending the reading wars: Reading acquisition from novice to expert. *Psychological Science in the Public Interest*, 19, 5–51.

EFFECTIVE INSTRUCTION AND BARAK ROSENSHINE

In 2012, Barak Rosenshine published his famous summary of the research on effective instruction, "Principles of Instruction: Research-Based Strategies That All Teachers Should Know" (American Educator, AFT).[15] Rosenshine based his principles on three sources: research in cognitive science, research in the classroom practices of master teachers, and research on cognitive supports to help students learn complex tasks. The principles are the following:

1. Begin a lesson with a short review of previous learning
2. Present new material in small steps, with practice after each step
3. Ask a lot of questions and check student responses
4. Provide models
5. Guide student practice
6. Check for student understanding
7. Obtain a high success rate
8. Provide scaffolds for difficult tasks
9. Require and monitor independent practice
10. Engage students in weekly and monthly review

Even now, these principles mesh not only with the more recent reports provided by Deans for Impact but also with the science of reading. As educators look for ways to provide instruction that enables all students to become readers, and as they seek commercial materials that support this goal, a solid body of research is available as guidance. Certainly, many commercial products purport to be research-based, but do they really adhere to the principles derived from cognitive science, from reading science, and from the work of Barak Rosenshine? Given the numbers of students, particularly our most marginalized students, who are not reading proficiently, it is urgent that educators have the knowledge they need and the effective tools they deserve that are grounded in the science of reading, the science of learning, and the principles of effective instruction.

15 Rosenshine, B. (2012). Principles of Instruction: Research-Based Strategies that All Teachers Should Know. Retrieved from https://www.aft.org/sites/default/files/periodicals/Rosenshine.pdf.

RECONCILING THE SCIENCE OF READING AND EFFECTIVE INSTRUCTION

To guarantee that educators know and can apply the science of reading and the science of learning within their schools and classrooms, changes are necessary:

- University teacher preparation programs must do a better job equipping teachers with a solid understanding of the science of reading and the science of learning.
- Publishers of curriculum materials, both internet-based and textbooks and other traditional materials, need to design their materials based on both sciences.
- In-service educator professional learning must be aligned to both the science of reading and the science of learning.
- School and district leaders need to fully understand the science of learning and the science of reading to be able to assist teachers and to ensure that appropriate materials and support are available.

If these recommendations are implemented, not only will more educators have a greater sense of efficacy, but, most critically, more children will become literate.