

Expanding the Science of Reading: The Critical Role of Varied Practice

By: Carolyn Brown, Ph.D. and Carolyn Strom, Ph.D.



What You'll Learn in this eBook

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Introduction

Across the country, educators have embraced early literacy instruction using systematic teaching grounded in the Science of Reading. Although students are developing foundational decoding skills, many still read slowly and without automaticity, stuck between decoding and fluency.^{26, 12, 25}

The assumption is explicit, systematic instruction sets the stage for accuracy and speed of word recognition, **naturally leading to fluency**. However, much research shows this is not true.^{26, 18, 17}

Between foundational skills and fluency lies a critical middle phase: practice. While the Science of Reading has built the foundation, the Science of Learning shows us how to design practice conditions that strengthen long-term memory, support generalization, and build automatic word recognition.^{8, 31, 24, 23}

“Acquisition of foundational skills is not enough. Practice is critical, but not all practice is equal.”

Dr. Carolyn Brown | Chief Academic Officer, Foundations in Learning

This educational guide reframes how we think about student practice. It explores:

- The crucial distinction between instruction vs. practice
- How practice impacts long-term memory and automatic retrieval
- 6 principles from cognitive science to make learning “stick”
- What rich and varied practice looks like in the classroom
- How these principles translate into daily practice

Fluency is not a byproduct of speed and accuracy. **It’s the outcome of systematic, structured, and varied practice designed to support automaticity.**

Instruction vs. Practice

The Learning Process Behind Fluency

In literacy conversations, ‘instruction’ and ‘practice’ are often used interchangeably, but they are not equal. The key difference lies in who owns the learning process.

Explicit instruction is the work of the teacher. It’s where we model, explain, and guide so students can begin to grasp what to pay attention to as they develop new knowledge and skills.

Practice is the work of the student.^{2,13} It’s the phase where their engagement in learning allows them to retrieve what they’ve learned, apply it, and strengthen it in their memory.

When we think about developing fluent readers, this distinction matters more than we think.

The Learning Process: What Cognitive Science Reveals

To understand why the transition to fluent, automatic reading is so difficult for some students, literacy researchers have gone outside of reading pedagogy and turned to cognitive science.^{6, 7, 9, 23, 27} For decades, cognitive scientists studied how novices in many fields became experts and what they’ve found is that fluency is marked by automaticity.^{20, 18}

Automaticity comes from the consolidation of learning in long-term memory. Consolidation, the process of reorganizing neural structures, moves students from novice instability (slow, effortful) to expert fluency (efficient, automatic).^{21, 11, 19}

This process requires systematic, structured, and varied practice and applies to orthographic, phonological, semantic, and syntactic systems in reading.



The principles that drive this practice are well established by the Science of Learning. **The process is known as proceduralization.**^{1,2} Proceduralization is the result of appropriate practice that moves “knowledge” to “skill.”

In terms of reading, this means students cannot become expert (fluent) readers without automatic word recognition.^{26, 12} Students’ reading skills have to be strengthened, connected, and made retrievable. **That’s where systematic, structured, and varied practice comes in.**

Practice that is simply repetitive does not lead to automatic word recognition.^{5, 31} Effective practice involves specific learning conditions that strengthen long-term memory, support generalization,¹⁰ and transform knowledge into automatic performance across contexts.

In Keith Apfelbaum’s study of first graders learning vowel correspondences, he found that students who practiced with highly variable words, rather than similar words, learned more and were better able to generalize their learning to new words.³

We can think of the journey this way:

INSTRUCTION



PRACTICE



FLUENCY

Instruction introduces knowledge. Practice consolidates it. Fluency emerges when that knowledge becomes automatic.

If we want fluent readers, we must focus on the conditions that lead to consolidation and automaticity.²² We must design practice as intentionally as we design our instruction.⁹

“Generalization occurs when students immediately recognize the regularities of the language when they see them in a new context. They don’t have to sound out words or remember rules. They automatically recognize patterns and generalize them to new words or connected text. They understand how the system works.”

Dr. Carolyn Brown | Chief Academic Officer, Foundations in Learning

Six Learning Principles That Make Practice Powerful

Designing Systematic, Structured, and Varied Practice for Lasting Learning

So how do we intentionally design practice that also keeps our students engaged? Cognitive science points to six key principles that:

- Strengthen memory
- Support generalization and flexibility
- Build automaticity

When implemented together through a systematic and structured curriculum, these principles ensure lasting learning.

Principle 1: Vary the Tasks

Present the same concept to students in multiple formats so patterns stand out across contexts.

When students encounter a pattern in the same format, their learning is narrow and they don't recognize regularities across contexts. When it appears in other tasks (such as reading, sorting, spelling, and connecting meaning), the pattern becomes recognizable and usable. **Variation helps regularities “pop,” increases flexibility of use, and improves generalization skills.**^{3, 10, 27}

CLASSROOM ACTIVITY: For early reading, this can include reading words in isolation, filling in missing parts of a word, reading words in sentences, sorting them by pattern, ordering syllables to make the word, or reading them in short passages.

“We are doing a great job at getting kids to decode. We are not doing as well when it comes to fostering engagement and joy as they break the code. But, there are ways we can do that.”

Dr. Carolyn Strom | Assistant Professor, NYU

Principle 2: Target Relevant Contrasts

Targeting relevant contrasts means intentionally highlighting key differences between patterns so students tell them apart.

Students perceive and recognize patterns as they learn to read. Categories emerge from repeated experiences with variation. If categories stay blurry, retrieval stays difficult. **By intentionally contrasting targeted sounds or spelling patterns, we sharpen those boundaries and strengthen discrimination.** Clearer distinctions lead to more precise, automatic retrieval, as well as to longer lasting learning.^{3, 22, 14}

Principle 3: Interleave the Content

Instead of focusing on one thing at a time, mix skills or concepts together during practice.^{29, 16, 10} In other words, don't ask students to practice skill A until it's perfect and then move to skill B.



Instead, mix A and B so students pay attention, discriminate different patterns, and decide which applies. Systematically interleaving skills and/or content sets up practice conditions that help students maintain their focus, enhance discrimination, improve flexibility, and transfer knowledge and skills.



Principle 4: Review, Rehearse, & Elaborate

Review, rehearsal, and elaboration strengthen learning, making it accessible and durable. These are powerful tools for consolidation. By revisiting, practicing, and extending learning, connections are coordinated to support automatic retrieval and fluency.

When students connect learning to existing knowledge, personal experiences, or even another language, they create more retrieval pathways. The new word or concept is easier to access later because it's associated with multiple connections.³² **Reviewing and elaborating increases engagement, helps with focus, strengthens retrieval, and supports consolidation.**^{8, 11, 32}

CLASSROOM ACTIVITY: Review can include remembering and discussing the theme or characters from a passage from the previous day. Elaboration can include students comparing and contrasting a passage with their own experiences, or predicting what might happen under different circumstances.



Principle 5: Control Levels of Difficulty

Adjust the level of difficulty in your lessons so learning feels effortful, but achievable. Practice that's too easy doesn't build durable memory, but practice that's too hard is overwhelming. **The right amount of challenge (desirable difficulties) requires students to actively process, retrieve, and apply knowledge rather than simply recognizing or repeating it.**^{4, 5, 31}

Sometimes performance appears slower, but planned, productive difficulty strengthens students' memories, enhances long-term retention, and makes retrieval more efficient and automatic.

CLASSROOM ACTIVITY: The difficulty level in a word recognition task can be elevated by integrating multi-syllable words with single syllable words that each have a targeted pattern (such as "ea" words) or reading short phrases that include the target words.

Principle 6: Provide Immediate Feedback

Provide students with timely feedback and support them in correcting errors. **Immediate feedback turns mistakes into useful learning information and helps students adjust their thinking while the task is still active.**

Immediate feedback helps keep practice in the right difficulty range^{4, 25}. When students receive quick correction and support, they strengthen pattern recognition and build more accurate automatic retrieval.

Immediate feedback also prevents mistakes from becoming habits and leads to increasingly accurate and efficient learning.

CLASSROOM ACTIVITY: In reading, this can mean quickly giving feedback on a decoding error, providing the correct pronunciation, and having the student immediately retry.

How to Apply The Six Principles to Classroom Activities at the Very Beginning of the Journey

These six principles should inform the content and structure of any early literacy curriculum. Results from the science of learning show that such curricula accelerate the path to fluency.

What does this look like in the classroom? Here are two sample activities that demonstrate how the principles work together.⁹

Important Reminder: These are not meant to be standalone or plug-and-play activities. These are examples from a systematic curriculum — activities designed to automatically move students to fluency.²³



Activity 1: Sound Play During Read-Aloud (Mrs. Millie Books)

Some read-aloud books, like the Mrs. Millie books by Judy Cox*, offer multiple ways to engage students in word play and sound contrasting activities.

In this activity from Dr. Carolyn Strom⁹, students distinguish the /g/ and /k/ sounds, while also thinking about sound patterns on a deeper level. Rather than isolating phonemic awareness in a drill, the contrast is embedded in meaningful language. Students listen more carefully, they compare patterns, and begin to connect sounds to other words they know.

PRINCIPLES AT WORK:

- Vary the Task
- Review and Elaborate



Every day she says, "Good morning, children.
Please hang up your goats."
"Don't be silly, Mrs. Millie! You mean our coats!"

TEACHER: What's funny about Mrs. Millie saying "hang up your goats?"

LASHAWN: Because we don't have **goats** at school. We got **coats!**

TEACHER: Good! Let's think about the difference? Goats has what **sound at the beginning of it?**

CLASS: /g/

TEACHER: What about **"coats?"** What's the **sound at the beginning?**

CLASS: /k/ (Then, Jayden raises hand)

TEACHER: Yes, Jayden?

JAYDEN: I think C ("See") and K ("Kay") are friends.

TEACHER: What do you mean?

JAYDEN: Because they both **make the /k/ sound**

*Cox, J. (2005). *Don't be silly, Mrs. Millie!* Illustrated by J. Mathieu. Marshall Cavendish.

Activity 2: Turtle Talk and Multiple Meanings

In another activity shared by Dr. Strom called “Turtle Talk”⁹, students begin by blending words slowly through the vowel — vet, shell, sheep, fish. After blending, students are invited to look for connections in both sound and meaning.

You can point out that the shell featured is a seashell, but of course, there is also a turtle’s “shell,” which is very different from a seashell. You can also expand on the multiple meanings of “fish”. It can be a noun as it is in this case, or “fish” can be a verb.

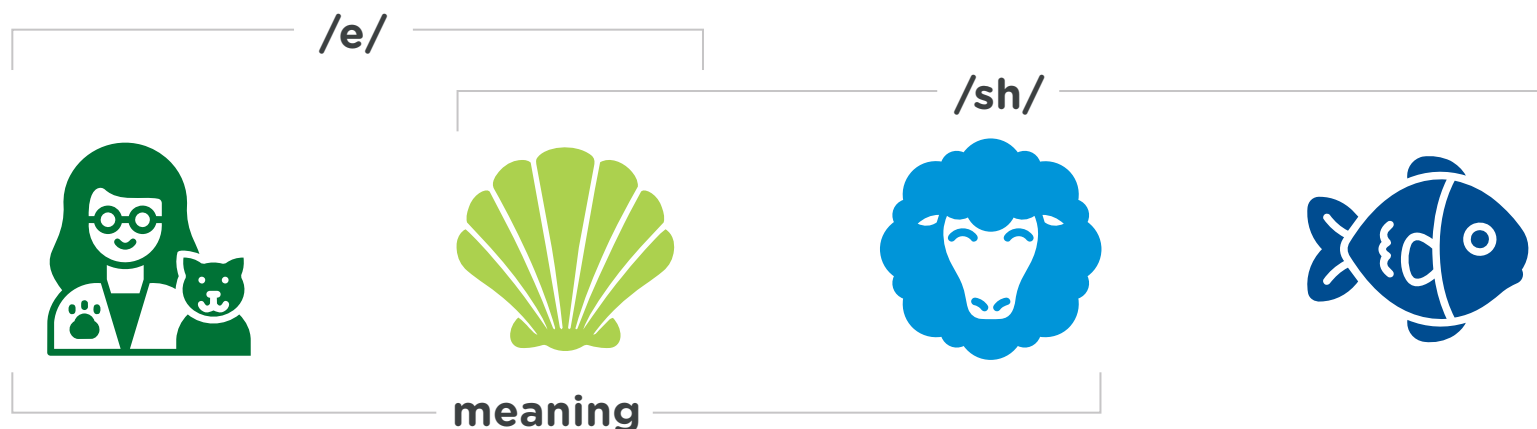
Students begin to notice shared vowel patterns (vet and shell both have /e/), or make connections between the words (shell, sheep and fish all have /sh/), and the shell and fish are both found in the ocean.

Blending remains the focus, but students now shift between sounds and meaning. This interleaving strengthens retrieval and deepens understanding, ultimately supporting automaticity and fluency.

PRINCIPLES AT WORK:

- Interleave the Content
- Review and Elaborate

How are the “Focus Four” related to each other in terms of **sound and/or meaning**?



The Role of Digital Practice for Today's Classrooms

Digital practice is an obvious way to incorporate the principles into the individualized, adaptive practice for striving readers.

When designed effectively, digital practice tools extend learning beyond whole-group or small-group instruction, giving students individualized practice opportunities at the right level of difficulty and pace to learn, apply, and strengthen what they know.

Independent practice with digital content should incorporate the same six principles discussed in this guide or students may end up spending time on a task without actually strengthening their skills.

When selecting a digital practice tool, consider the following:

- Is the structure of the curriculum organized to systematically build knowledge and use of skills?
- Are learning principles embedded into the tools' design?
- Is the practice personalized to meet each student's learning level and needs?
- Is feedback immediate and specific?

WordFlight is an evidence-based literacy intervention^{23, 6, 7} that systematically integrates findings from 50 years of learning science on the development of automaticity and fluency. It was intentionally built and empirically tested around these six learning principles. In the program, students encounter activities for automaticity and reading fluency, such as:

- Syllable counting tasks
- Word change activities
- Fill in missing letters
- Spell words
- Recognize words and phrases
- Identify meanings of words
- Order syllables
- Identify meaning of morphemes
- Use morphemes to build new words
- Listen to and read short passages
- Answer comprehension questions

Additionally, WordFlight has the only patented assessment of automaticity so educators can measure progress towards fluency. Students follow a structured and systematic sequence tailored to their specific learning level, intentionally designed to move them to fluency.

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About WordFlight

WordFlight takes a new approach to helping students achieve reading fluency and build their confidence in reading. WordFlight bridges the gap between decoding and fluency using evidence from the Science of Reading and the Science of Learning.



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WordFlight was developed with support from the U.S. Department of Education Institute for Education Sciences (IES) grant funds and with research support from the University of Iowa. WordFlight serves students in grades 3+ who are one or more years behind in reading comprehension and/or fluency.