Comprehension in Disguise
The Role of Knowledge in Children's Learning

by Susan B. Neuman

Although many contentious issues still plague the field of reading, most scholars would agree on this particular topic: Reading comprehension is critically important to the development of children's reading skills. Comprehension entails the understanding of written text, a process in which information from the text and the knowledge possessed by the reader act together to produce meaning (Anderson, Hiebert, Scott, & Wilkinson, 1985). In this respect, the text is not so much a vessel containing meaning as a source of partial information that enables the reader to use already-possessed knowledge to determine an intended meaning.

In fact, one could argue that there has emerged a rare consensus among researchers on how comprehension works (National Reading Panel Report, 2000). Rather than a set of isolated skills, reading is a complex, active process of constructing meaning. In addition to gaining information from the letters and words in a text, reading involves selecting and using knowledge about people, places, and things, and knowledge about texts and their organization. It is interactive, strategic, and adaptive, involving not just the reader, but the context, the purpose, and the different types of text and how they are used for different kinds of reading (Dole, Duffy, Roehler, & Pearson, 1991). In short, good readers skillfully integrate new information in the text with what they already know to produce meaning.

If this sounds like a rather exotic recipe, you are not alone. Boil it down, and this is what you get: Comprehension is about bringing what you *already* know to what you may want to learn. And the antecedent for whether you are selective, strategic, and interactive in monitoring your comprehension is a widely acknowledged but often overlooked factor: knowledge.

Not entirely overlooked, however. Starting with the National Commission on Reading's report, Becoming a Nation of Readers (Anderson et al., 1985), and continuing with the National Reading Panel report (2000) and other National Academy updates (Snow, Burns, & Griffin, 1998; Bransford, Brown, & Cocking, 2000), background knowledge has always been in the mix in concocting this elixir. Students have been encouraged to "activate" their background knowledge when reading a text. But just in case you do not have any knowledge on the topic to activate, there are other remedies as well. The National Reading Panel Report, for example, highlights a host of different techniques including asking yourself questions, strategizing, summarizing, and figuring out the story or text structure.

If you find that these potential remedies fail a basic logic test, you would have company. For in order to be able to ask a reasonable question, it makes sense that you need to have at least some comprehension. Similarly, to summarize a text accurately, you would likely know something about it. And while recognizing the structure of a text might give you some indication of what to look for, it would hardly be sufficient to understand what the section of the particular text might actually mean.

All of this might strike educators as paradoxical and impractical, at least when reading comprehension is regarded as a generic skill. But what if instead comprehension is seen as the development of knowledge networks built and sustained by applying research-based principles?

The Case Against Comprehension as a Generic Skill

Comprehension is the process of constructing meaning from text. So, let's start with a simple example adapted from the Becoming a Nation of Readers' consensus report (Anderson et al., 1985):

> When Melissa arrived at the restaurant, the woman at the door greeted her, checked her coat and looked for her name. A few minutes later, Melissa was escorted to her table, and shown the daily specials. The attendant was helpful but brusque, almost to the point of being rude. Later, she paid the woman at the door and left.

For those reading this text, it probably brings to mind past associations with restaurants. The woman at the door is the maître d'; the attendant is the waiter or waitress. However, no text is completely self-explanatory. Throughout the reading, you probably made connections and inferences based on the text and the knowledge you already possess. But take a minute more to look at the last two sentences, and here it gets a bit more complicated. Why did Melissa probably pay the maître d' and not the waiter? One could infer that Melissa was angry with the poor service and chose not to leave a tip.

The paragraph highlights several important points about comprehension. In interpreting text, readers draw on their store of knowledge about the topic. You were able to use your prior knowledge to fill in the gaps in the message and integrate the different pieces of information in the message. As someone probably familiar with restaurants, you were able to infer that Melissa had a reservation, was directed to the table, selected her meal from the daily specials on the menu, and was likely

Abbreviation

SES: Socioeconomic status

frustrated with the service she received. Yet none of this information is expressly mentioned in the text.

These are all inferences that bring together the information presented in the text and the knowledge the reader already has about restaurants. Good readers, according to these consensus reports, are thought to integrate information in the text with what they already know, whereas less mature readers may struggle with its meaning. However, here's the irony. Although good readers may read the above paragraph with greater fluency than less mature readers, the inferences they make are not likely based on their overall ability to monitor their comprehension or make inferences. Rather, whether good or poor readers, those inferences had to do with their knowledge of what goes on in a restaurant. With more knowledge, a reader could likely make sense of the text and fill in those gaps.

Now let's try another paragraph, this time from an informational science text. The text reads as follows:

> The fastest mammal on land, the cheetah can reach speeds of 60 or perhaps 70 miles an hour over short distances. It usually chases its prey at only about half that speed, however. After a chase, a cheetah needs half an hour to catch its breath before it can eat.

Typical of many exercises, this brief paragraph is followed by a set of comprehension questions. The first, "What is the cheetah?" is right there in the text, and can probably be easily answered by saying, "It's the fastest mammal on land." Similarly, the second question, "How fast can the cheetah run?" is another example of a literal question, right there in the text. But the third question attempts to go a bit deeper, asking "Why would the cheetah slow down to catch its prey?" To answer this question, you'd have to go beyond the literal text to make an inference. You would need to know the meaning of the vocabulary word, "prey." And to make an accurate inference, you'd probably have to know something about mammals, and how they often stalk their victims.

If knowledge is merely a supporting player, then it might only represent the existing schemas readers bring to the text, essentially a static characteristic that one applies while reading. But if we reverse roles, placing knowledge on center stage, we now see knowledge as an alterable characteristic, one that needs to be developed and nurtured.

No educator would likely quibble with the conclusion that background knowledge played a role in comprehending these paragraphs. The problem, however, has been in defining that role. For example, if knowledge is merely a supporting player, then it might only represent the existing schemas readers bring to the text, essentially a static characteristic that one applies while reading. But if we reverse roles, placing knowledge on center stage, we now see knowledge as an alterable characteristic, one that needs to be developed and nurtured.

These distinctions are important because the previous limited role of knowledge in comprehension instruction has placed low-income children at a great disadvantage. This became all too clear in a three-part experiment with children from low-income and middle-income families (Kaefer, Neuman, & Pinkham, 2014). In the first experiment we assessed preschoolers' background knowledge about birds by creating a task with fictional characters and names. "This is a toma. A toma is a bird. Can a toma live in a nest?" and other items in a similar format. As predicted, low-income (defined by socioeconomic status, or SES) children had significantly more limited background knowledge than their middle-income peers. We then created a storybook that featured the adventures of four types of birds. After the reading, we asked children to make causal inferences about the story, and once again, found the low-SES children scored significantly lower than the middle-income children.

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But in our third experiment we neutralized background knowledge by introducing a storybook narrative that would include a novel topic to both groups of children. The storybook used a novel category (i.e., wugs, a pseudoword) and was designed around the adventures of four species of wugs. Here was our reasoning: If children's preexisting background knowledge underlies these differences in comprehension, then we would expect that there would be no differences in learning among our differing SES groups. And our results confirmed our hypothesis: Low-income and middle-income children scored similarly in word learning, comprehension, and the ability to make inferences. In other words, the differences between groups were not in the skills associated with comprehension (e.g., inferencing) but in the knowledge to make these words comprehensible.

If this were the only study to highlight the starring role of knowledge, in contrast to its supporting role, then more research would be needed. However, its contribution to comprehension, vocabulary, and learning has been well-established among cognitive scientists, linguists, educators, and computer scientists for years (Hambrick, 2003). For example, Dick Anderson and Peter Freebody formulated the knowledge hypothesis (Anderson & Freebody, 1979) to explain how the size of one's vocabulary was actually a measure of one's deeper and broader knowledge. Processing certain word meanings (e.g., vocabulary) is only a sign that the individual may possess some

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knowledge of a topic. For instance, the child who knows the word *mast* is likely to have some knowledge about sailing. Instructional practices, however, have tended to focus on "word meanings" rather than the knowledge networks they represent. In fact, whether it's comprehension, vocabulary development, content learning, critical thinking, or problem-solving, one might attribute learning to a single variable: When one has some knowledge, it's easier to develop more knowledge. Simply put, knowledge is power in cognitive development.

Developing Knowledge Networks

If we recognize that knowledge is not a static characteristic, but rather one that is highly alterable, then how do we develop it? Children need a fairly extensive knowledge network of vocabulary and concepts to read and successfully comprehend in later grades. But to get started, we begin in the early years to help children organize large amounts of information into meaningful networks with plenty of opportunities for repeated practice and extended learning (Neuman & Wright, 2013).

In our research studies of vocabulary, we use shared book reading time as an opportunity to expand children's content knowledge in science and mathematics. Topics in science, for example, *wild weather* and *habitats,* tend to intrigue children, and they also provide rich opportunities to build content and conceptual knowledge essential for developing knowledge networks. For example, if children learn that *tornadoes, blizzards,* and *hurricanes* are all a type of *wild weather*, they begin to understand certain properties of a category: that wild weather can cause damage, and that people need to take safety precautions.

Based on our research, knowing a word's meaning is not sufficient unless it is tied to a network of concepts that helps children understand their world. Using both narrative nonfiction books and informational text, we work to deepen their knowledge about a particular topic, introducing additional content-related words throughout our sessions. We concentrate on the topic over three weeks, building and adding new words along the way, so that by the end, children have acquired over 100 words connected to a network of concepts.

These knowledge networks act like schemas, a type of organizational prosthetic that can serve to diminish the information-processing load in future learning. As children learn about new words within a topic, they begin to form a mental representation of these concepts, devoting less mental energy to how words relate to one another. For example, if children are introduced to the word *hurricane* as a type of wild weather, they can begin to understand the properties of a category; in this case, that wild weather can be damaging and destructive, and they need to find shelter. In this respect, learning words in categories has inductive potential (Neuman, Newman, & Dwyer, 2011). By diminishing the information-processing load, children are able to access existing knowledge and acquire new information more rapidly (Neuman, 2001). Understanding the basic concept of wild weather, for example, enables children to quickly make new associations, creating additional and refined schemas (e.g., tropical wild weather) that become increasingly differentiated with more knowledge. In this respect, as Hirsch has powerfully demonstrated (Hirsch, 2006), "knowledge begets knowledge."

Five Research-Based Principles to Build Knowledge Networks

Based on what we've learned about developing knowledge networks, we propose five instructional principles that thread throughout our work and that of other researchers (Gonzalez et al., 2011) who have focused on knowledge-rich instruction.

Principle #1: Big Ideas. We start our planning process with the big ideas we want children to learn. Big ideas are concepts and principles that allow for the most efficient and broadest acquisition of knowledge across a range of examples in a domain (Neuman & Wright, 2013; Pollard-Durodola et al., 2012). For example, big ideas in our topic of "marine mammals" include the fact that they have life cycles, have ways of protecting themselves, and live in habitats based on their needs (see Figure 1). These big ideas serve as cross-cutting themes, linking one topic to another. Insects, pets, and wild animals, for instance, will share these common features, allowing children to understand commonalities across this broad domain (e.g., living things). Big ideas, therefore, serve to emphasize what is important, while concepts focus on smaller units of knowledge. In the case of marine mammals, we focus on concepts like how whales, manatees, and seals all have lungs and breathe oxygen. Words cluster around a concept with similar properties.

Many of our children come to school with significant disparities in their depth and breadth of knowledge. We do them harm when we *assume* that they have the background experiences to activate knowledge. Rather, to significantly close these gaps, we need to identify the domains of knowledge they will need to possess and teach them deeply.

Principle #2: Word Knowledge. Vocabulary is children's entry to knowledge and the world of ideas. In order to have a good conversation or inquiry lesson in science, for example, children need a threshold of content-specific words in order to talk about their ideas.

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We need to focus intensively on vocabulary in the earliest grades. Words are learned incrementally and cumulatively after many different exposures. As children encounter a word repeatedly and in multiple contexts, they accumulate more and more knowledge. To develop a deeper understanding of words, we

start with child-friendly definitions of words, making sure that children have a common understanding of them, and review them frequently through our shared reading activities.

We select words in categorical sets (e.g., manatee, whale, seal) to help children begin to develop imagery and mental models of concepts (Neuman & Kaefer, 2013; 2018). In this respect, we strongly depart from the notion of "Tier 2" words, often described as words used by mature language users (i.e., sophisticated) across a wide variety of domains. Because of their lack of redundancy in oral language, Tier 2 words (e.g., *obvious, verify*) can present challenges to young children who primarily meet them in print. Rather, we select words to focus on our big ideas and identify important, depictable words that are thematically related and that can be applied to higher-order concepts. Often described as "Tier 3," these words are central to building knowledge and conceptual understanding and are integral to content learning in various academic domains. For instance, children learn to classify vocabulary pictures by categories (e.g., this is a living thing; this is not a living thing), and to describe how words relate to one another. For example, seals and otters are both a type of marine mammal. This helps children to understand how words may be hierarchically related to concepts.

Principle #3. The Use of Multiple Genres. Children develop deeper knowledge when they are exposed to a topic through multiple genres (Neuman & Kaefer, 2018). For example, storybook narratives, particularly narrative nonfiction books, are a wonderful source for learning new words and developing an emotional connection between the characters and the topic. On the other hand, informational books often include more dense vocabulary, concepts, and are likely to provide factual information about the social and natural world. When we use both genres (narrative nonfiction, informational) we can provide a more intensive experience for children, allowing them to deeply process lexical sets of content vocabulary and related concepts. That is, the integration of texts in topical units promotes both frequent encounters with words and knowledge across book genres and creates a deeper and more thorough understanding of the topic.

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Principle #4. Distributed Review. Successful learning also depends on distributed review to reinforce the essential building blocks of information within a content domain. However, simple repetition of information won't reliably ensure learning. According to research (Simmons, Pollard-Durodola, Gonzalez, Davis, & Simmons, 2008), review requires: i) sufficient amount of time on a topic; ii) that it be distributed over time (e.g., not in one dose); iii) that it be cumulative, with less complex information integrated into more complex tasks, and iv) varied contexts to illustrate its wide application to children's understanding of information.

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MARINE ANIMALS

At a Glance:

Big Ideas:

- **MARINE ANIMALS** have life cycles.
- **MARINE ANIMALS** live in certain habitats based on their needs.
- **MARINE ANIMALS** have ways of protecting themselves.

In this topic, children will learn that:

- **MARINE ANIMALS** are living things.
- **MARINE ANIMALS** spend their whole lives in or around water.
- **MARINE ANIMALS** get their food from their water habitat.
- **MARINE ANIMALS** live in different zones of the ocean, some warm and some cold.
- **MARINE ANIMALS** either hatch from eggs, are born alive, or duplicate themselves.
- There is a large variety of **MARINE ANIMALS**; some microscopic and others extremely large.

Resources:

Lesson Plan

5 Shared Reading Books

Picture Cards

MARINE ANIMALS Vocabulary:

- **Types of MARINE ANIMALS:** ***anemone, coral, dolphin, eel, manatee, shark, whale***
- **Words that help us talk about MARINE ANIMALS:** ***aquarium, blubber, coast, seaweed***
- **Challenge Words:** ***frog, octopus, polar bear, seashell***

WOW WORLD of WORDS

Figure 1. World of Words Marine Animals

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Principle #5: Intentional Opportunities for Language Engagement. Opportunities to talk about and more deeply process information are essential for developing knowledge. Children will need to build a strong oral language foundation in conjunction with many opportunities to learn content and connected concepts (Neuman, Pinkham, & Kaefer, 2015). One instructional technique that we have used is to have children make contrasts and comparisons—to describe what is similar or different about the properties of certain concepts. For example, we give children puzzlers like, "Is an artichoke a type of fruit? Why is it or is it not a kind of fruit?" Puzzlers help children think outside the immediate context and consider the reasoning behind the contrasts and comprehension, which can further stretch their understanding of categories and concepts. This type of activity requires more complex thinking and encourages them to problem-solve, helping children manipulate the knowledge that they are acquiring to develop new knowledge.

Knowledge as a Foundation for Comprehension

Comprehension is critically important to children's reading success. Yet despite the numerous consensus reports on the extant research on comprehension, we have ignored the factor that most powerfully predicts it: knowledge. Instead, we have fallen prey to quick fixes, a wish fulfillment that some sort of monitoring, activation, or strategy might repair what has been lacking in background knowledge.

It hasn't worked. Children's reading comprehension scores have not substantially improved on any measure, no matter what nationally recognized assessment you may reference (Baldi, Jin, Skemer, Green, & Herget, 2007; National Assessment of Educational Progress (NAEP), 2018). Despite the enormous investments in education and reading remediation, we remain essentially at a standstill in terms of achievement. But perhaps even more tragically, our focus on comprehension strategies, almost as if they were magical potions, has taken time away from the kind of instruction that would benefit economically disadvantaged children. For many of these children, the stresses and realities of poverty have led to more limited access to resources, affecting their initial background knowledge of concepts and vocabulary critical for comprehension and later learning. Furthermore, with limited background knowledge, the newer demands of state standards emphasizing more challenging narrative and informational texts have placed them at even greater disadvantage, only magnifying other risk factors.

These children will need skillfully engineered systematic instruction that is rich in content and that maximizes the valuable resource of time. Without greater efforts to enhance knowledge, differences in children's background experiences may further exacerbate the differences in children's comprehension. Consequently, the imperative to foster children's knowledge as a means for providing a firm foundation for comprehension and learning is greater than ever. Our children deserve no less.

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