Moving Beyond the Page in Content Area Literacy: Comprehension Instruction for Multimodal Texts in Science

Amy Alexandra Wilson

Soon after they observed and drew the moon in its different phases for a month, the sixth-grade students sat huddled together on the floor in the main atrium of their U.S. middle school. Their teacher Ms. Thompson (pseudonym) held up a black and yellow foam ball, stating, "This is the moon." A student explained to the class that the bright half of the ball represented the part of the moon that was lit by the sun, while the dark half represented the side of the moon that was not lit by the sun. Ms. Thompson pointed down a long hallway, at the end of which the sun's rays shone brightly through glass doors. "That is the sun," she said, making sure she stood so that the sun's rays hit the side of the moon that was yellow. Ms. Thompson then informed her students, "You are the earth." With the moon held high, she revolved around her students in a circle, asking them each to record what they saw of the moon as she stood in different positions. Her students told her when it was a full moon, a new moon, and a quarter moon, depending on where she was standing.

Intrigued by what would happen next, Ms. Thompson's students followed her into a dark storage closet. This time, they stood in a circle, surveying the room with no windows, lit only by a lamp in the center that represented the sun. Each student's head was now the earth, and the moon was a polystyrene ball stuck onto a pencil in each student's hand. Leading students through a series of turns, Ms. Thompson demonstrated again how the moon's revolution around the earth caused different lunar phases. Students returned to their assigned tables in their classrooms as they began their responses to the prompt, "Explain what causes the phases of the moon." As they sat and discussed this prompt in cooperative groups, Ms. Thompson walked around the room to field questions and to help students write their explanations.

Ms. Thompson's lesson was exemplary for many reasons. It demonstrated her high degree of expertise in using pedagogical content knowledge to make potentially difficult concepts understandable to students (Shulman, 1987). As Shulman explained, excellent content area teachers comprehend difficult concepts and can then "transform" them into multiple "representations" such as "analogies, metaphors, examples, demonstrations, explanations, and so forth" (p. 15) that meet the unique educational needs of particular classrooms. Indeed, Ms. Thompson transformed her content knowledge "into forms that [were] pedagogically powerful" (p. 15), and many students came away with an understanding of the phases of the moon, as evidenced by their subsequent writings.

Yet when one student returned to the classroom without writing and finally asked Ms. Thompson to explain the phases of the moon to him, he revealed the potential limitations of simply transforming content from one type of representation (e.g., a textbook) into another (e.g., a demonstration) to make concepts understandable to some students. Nonprint forms of representation—such as demonstrations, videos, and diagrams—are themselves texts. Moreover, just as students deserve explicit instruction on how to access the content in texts with words, they also deserve explicit instruction on how to access the content in other types of texts. Furthermore, they deserve explicit instruction on how to represent content in a variety of textual forms themselves.

These textual forms are at the very heart of science (Lemke, 1998). For instance, students must "read" and be able to make sense of a three-dimensional model of the digestive system, just as they must be able to make sense of any accompanying explanatory written text. Ms. Thompson understood this principle and supplemented her unit with models, demonstrations, and videos of the earth in

The Reading Teacher, 62(2), pp. 153–156
DOI:10.1598/RT.62.2.7

ISSN: 0034-0561 print / 1936-2714 online

relation to other celestial bodies. Because science inherently requires the use of these multiple sign systems, scientific literacy accordingly involves the comprehension of multimodal texts, or texts that convey meaning through multiple sign systems such as gestures, spoken words, written words, numeric equations, photographs, diagrams, and so forth. Therefore, literacy instruction in science classrooms must prepare students to understand, critically evaluate, and design these multimodal texts.

Imagining New Possibilities

Fortunately for the student who at first did not understand multimodal texts about the moon, Ms. Thompson worked with him until he could explain the causes of lunar phases. For other teachers who, like Ms. Thompson, want to help their students understand the multimodal texts that are vital to their discipline, the following section contains teaching tips based on research and theoretical literature and includes Ms. Thompson's lesson as a concrete example of how these teaching tips can be applied.

Tip 1: Teach tried-and-true comprehension strategies when they apply to nonprint texts. Some comprehension strategies, such as skimming ahead or pausing the reading of the text for a moment to reflect and take notes in the margins, may clearly not be sensible strategies to apply to texts such as demonstrations. On the other hand, asking students to predict which type of moon will appear next in the demonstration, to check their predictions, to monitor their comprehension and ask clarification questions, to infer why different phases of the moon have the names they do, and to find main ideas are all applicable comprehension strategies (Block & Pressley, 2002). Whereas finding the main ideas in a printed text may involve reading headings and subheadings, finding the main idea in a demonstration may involve a listing of the major objects within it (e.g., the sun, the moon, the earth) and the actions performed by each of the major objects (e.g., the moon revolved around the earth and the sun shone on the moon). Making text-to-text connections—in this case, making connections between demonstrations—would also help students find the main ideas: The sun, the earth, and the moon were prominently featured in both demonstrations, with the moon and the sun performing the same actions in both settings. As students apply comprehension strategies across various kinds of texts, they can also discuss how and when these strategies are appropriate and how they can be modified to meet the unique demands of specific modes (See Table 1).

Tip 2: Evaluate the affordances and limitations of different representations. All texts have affordances, or potential uses (van Leeuwen, 2005), that enable them to meet the needs and interests of the people reading, viewing, or hearing them. For instance, a road map affords the opportunity for drivers to see the spatial, scaled relationships between roads, whereas a limitation of spoken words is that they are fleeting and may not enable the listener to fully visualize the relationships between a set of roads. If drivers became lost, they could not use spoken words as a record of spatial relationships to help them find their location. When this principle is applied to science, students who can identify the affordances and limitations of multimodal texts can be more critical readers and better communicators of scientific content. For example, as an extension of this particular lesson, students could identify the limitations of the different representations used. In this case, the lamp was limited in its ability to represent the sun: It could not convey its extreme heat, its relatively large size, and its constant movement.

As Freebody, Luke, and Gilbert (1991) asserted, all texts are a particular version of reality. By extension, the types of representation used in texts convey only partial versions of phenomena as well. To help students learn that representations are always selective and incomplete versions of reality, teachers could ask them to evaluate related texts in various modes. In this case, they could find two websites about lunar phases (perhaps from a teacher-generated list of websites), evaluate the forms of representations used in each one, and state which text they found to be the clearest and most accurate conveyor of information. Websites with still images and diagrams alone may not be the most useful purveyors of ideas in this instance, because lunar phases are caused in large part by the revolution of the moon around the earth. Therefore, students may state that websites with moving images are the best representations of this information because they allow viewers to see the moving nature of the three celestial objects.

Tip 3: Ask students to design texts using different forms of representation and to explain why they chose the forms that they did. The New London Group (1996) described the principle of design as

Table 1
Teaching Multimodal Texts in Science

Principle for teaching multimodal texts	Examples of specific applications
Students should be metacognitive, or aware of the status of their own comprehension, as they make sense of multimodal science texts.	■ Teachers can conduct a think-aloud on a lab or demonstration, including modeling for students where they don't understand why a physical reaction happened, and then ask their students to do the same during labs.
Students should apply comprehension strategies as they read, view, and listen to multimodal texts.	■ In a demonstration or lab, ask students to identify the one or two most important factors that caused the phenomenon to occur and to justify why they chose that factor. ■ Ask students to explicitly connect a demonstration, a passage from a textbook, a diagram, or a video clip to another text or to natural phenomena they observe in their own lives.
Students should be aware of the affordances and limitations in different representations of scientific content, including their own representations.	■ Ask students to demonstrate a scientific concept in three different ways, speculate on which of the ways they thought most clearly conveyed the content, and explain why. ■ Show students a scientific concept in one mode (e.g., a written paragraph explaining the respiratory system) and ask them to see if they could convey the content in a better way (e.g., through a written paragraph *and* a diagram or three-dimensional model). Ask them to explain why their new representation is better.

taking available preexisting designs and transforming them into a redesigned text. According to this theory, the creators of texts choose from a variety of available templates (charts, diagrams, gestures, written texts, websites, photographs, computer graphics, videos, comics, any combination of these, and more) to make a redesigned text using the templates of preexisting texts.

When the principle of design is applied to this particular lesson, students could be asked to imagine they were creating their own website in which they would explain the causes of lunar phases. Ideally, after the modeling and discussing of several example texts, students would be able to design a digital text. Alternatively, due to some classes' limited access to up-to-date computer labs, students might complete this activity without a computer as well, simply by imagining what they would do in a website. In either case, students would have to explain why they chose different forms of representation (e.g., moving images, expository text with headings, labeled still photographs of the moon, or a scientist's journal entries) to convey content.

Furthermore, they could subsequently discuss the affordances and limitations of their selected textual forms when they shared their proposed designs in groups or with the class. According to Pauwels (2006), "The issue of representation touches upon the very essence of all scientific activity. What is known and passed on as science is the result of a series of representational practices" (p. vii). Other scientists have echoed his assertion as well (e.g., Lemke, 1998), underscoring the importance of explicitly teaching students how to read and write different types of representations as a key component of scientific literacy. As a result, teachers cannot be content to encourage students to apply comprehension strategies as they read words on a printed page, no matter how important and useful those strategies might be. Instead teachers can open up conversations about the mode of the text itself—about how the designer of the text is conveying, omitting, and creating certain aspects

of reality as he or she uses certain representational modes. These conversations can also encourage students to be self-reflective as they, in turn, create fitting scientific representations.

The Content Area Classroom and Beyond

As students evaluate multiple forms of representation, and as they design texts in different modes, they may not only understand discipline-specific concepts more fully, but also they may become more adept designers of multimodal texts. This skill is crucial in today's world, where students are faced with a vast array of modes and representations on computer, television, and cell phone screens. Furthermore, technology continually changes so that today's instruction on reading and designing texts may inevitably be insufficient tomorrow. Teachers—including those in the content areas—may not be able to teach students how to read and design all forms of texts. But they can open up discussions that cause students to reflect on different representations, on how these representations construct certain aspects of reality and omit others, and on how comprehension strategies might be used across various modes. Rather than detracting from content, this type of literacy instruction enhances it: Students understand scientific content better when they can present it in more than one mode (Prain & Waldrip, 2006), and they become more critical readers and designers when they can interrogate the affordances and limitations of a text.

Preparing students to be literate in the 21st century is no easy task. Students encounter multiple representations of content in school and an ever-increasing range of textual forms outside of school. To help students meet these challenges, it will take the concerted efforts of teachers across the content areas to support their students in understanding, critiquing, and designing a variety of texts. Students who learn how to evaluate and create texts using multiple types of representations will be better prepared to become powerful and critical participants in school and society, now and in the years to come.

Note

The author wishes to acknowledge Katherine A. Dougherty Stahl and the International Reading Association for the Steven A. Stahl Research Grant, which funded the research that formed the basis for this article.

References

Block, C.C., & Pressley, M. (Eds.). (2002). *Comprehension instruction: Research-based best practices*. New York: Guilford.

Freebody, P., Luke, A., & Gilbert, P. (1991). Reading positions and practices in the classroom. *Curriculum Inquiry*, *21*(4), 435–457. doi:10.2307/1180176

Lemke, J.L. (1998). Multiplying meaning: Visual and verbal semiotics in scientific text. In J.R. Martin & R. Veel (Eds.), *Reading science: Critical and functional perspectives on discourses of science* (pp. 87–113). London: Routledge.

New London Group. (1996). A pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review*, *66*(1), 60–92.

Pauwels, L. (2006). Introduction: The role of visual representation in the production of scientific reality. In L. Pauwels (Ed.), *Visual cultures of science: Rethinking representational practices in knowledge building and science communication* (pp. vii–xix). Hanover, NH: Dartmouth College Press.

Prain, V., & Waldrip, B. (2006). An exploratory study of teachers' and students' use of multimodal representations of concepts in primary science. *International Journal of Science Education*, *28*(15), 1843–1866. doi:10.1080/09500690600718294

Shulman, L.S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, *57*(1), 1–22.

van Leeuwen, T. (2005). *Introducing social semiotics*. London: Routledge.

Wilson is a graduate student in the Language and Literacy Education Department at the University of Georgia, Athens, USA. E-mail aawilson@uga.edu.

Lesson Link

For a related lesson plan, visit ReadWriteThink.org and click Lessons to find

- **Critical Literacy in Action: Mulitmodal Texts on Global Warming**