Modeling Expert Thinking

Students learn more when they have the opportunity to listen to how the teacher thinks and solves problems.

By Nancy Frey and Douglas Fisher

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The ninth-grade Earth Science class is focused on live video streamed from a news agency showing the eruption of a small volcano located near the Eyjafjallajökull glacier in Iceland. The teacher narrates what he is seeing as he watches with his class. "As I’m watching this, I’m thinking about how unique this eruption is," he says. "With most volcanoes, there are earthquakes that signal something might be happening. But these volcanoes around Iceland don’t give any warning. I checked on the USGS Web site, and the tremors were really small."

He continues, "I’m also noticing that the eruption is more like a fissure. See how it’s tearing here?" He gestures. "It’s awfully close to this glacier. If the fissure keeps widening, it’s going to have an impact on the glacier itself."

The teacher concludes, "I know this area [in Iceland] is where the Eurasian and North American tectonic plates meet, because I looked on this map. I’m guessing that there's been significant movement of those plates, and this volcanic eruption is the result."

Without the teacher’s exposure of his thinking, his students would be left to their own devices to draw conclusions about the natural disaster they were witnessing. In a matter of two minutes, the teacher demonstrated how he used his background knowledge ("I’m thinking about how unique this eruption is"), consulted resources (the United States Geological Survey and a tectonic plate map), applied expert noticing ("See how it’s tearing here?") and speculated ("I’m guessing that there’s been significant movement"). This teacher’s use of a think-aloud procedure is an example of how expertise is shared in the classroom. Students deserve, at some point in the lesson, to experience the curriculum from an expert’s perspective. This provides them an opportunity to imitate the expert thinking, almost like an apprentice would in learning a new skill. Imitation is one of the ways humans learn, and modeling taps into this system (Fisher, Frey, & Lapp, 2008).

Thinking Like an Expert

Teachers regularly use modeling and demonstration to show students how a skill, a strategy, or a concept is used. Although it’s often associated with such performance tasks as swinging a tennis racket or playing a musical instrument, modeling is equally effective for cognitive and metacognitive tasks. Modeling includes naming the task or the strategy, explaining when it is used, and using analogies to link new learning to familiar information. The teacher then demonstrates the task or the strategy, alerts learners about errors to avoid, and shows them how it is applied to check for accuracy. Modeling is often accompanied by a think-aloud procedure (Davey, 1983) to further expose the decisions made by an expert as he or she processes information. For this reason, the think aloud consistently contains "I" statements to invite the learner into the mind of the teacher.

This is a profound shift from what most teachers are accustomed to doing. Much of classroom instruction is in the second person and is interrogative in nature ("When you look at this eruption, what do you see?"). Lecturing and quizzing become the order of the day, and students walk away from the class under the false assumption that somehow the teacher just "knows" the answers. They are not made privy to the speculative, at times hesitant, thinking of the content...
expert. What's lost are the natural stutter steps made by someone who is deeply knowledgeable of the complexities of the topic.

It's understandable that many teachers struggle with making this a part of instruction. The majority of instruction they have encountered has been interrogative. They don't have an internalized model of what an effective think aloud sounds like. Therefore, it's useful to introduce teachers to some indicators of high-quality modeling and thinking aloud. We've found it particularly helpful for teachers to watch one another model thinking aloud and then talk about how it felt, both as the person modeling and the person observing expert thinking. Some indicators we look for during teacher modeling include:

- Naming a strategy, a skill, or a task
- Stating the purpose of the strategy, the skill, or the task
- Using "I" statements
- Demonstrating how the strategy, the skill, or the task is used
- Alerting learners about errors to avoid
- Assessing the usefulness of the strategy or the skill.

Consider a mathematics teacher's modeling for solving problems with exponents. In this case, the exponents had variables in them: $2^{x^3} = 4^x$. While modeling, the teacher said, "I see that the bases aren't equal, so I can't yet set the exponents equal. If I can get the bases equal, then I know that the exponents are equal. The strategy I can try is factoring because it might help me get the bases to be equal. I can't factor the left side any further, but I can factor the right side of the equation. Using my factor tree, I see that four can be factored into $2^2$. But I have to be careful about the distributive property. I know that if I don't put parentheses around the exponents, I might forget to distribute the exponents correctly. Now that I have the bases equal, I know that the exponents are equal. So my next step is to rewrite the equation, $x^3 = 4^x$. And now, I just crank it through. When I get down to it, I think that the answer is 1. But I know that I'm not done yet. I have to check my answer by plugging it back into the original equation."

Although one problem modeled in this way may not result in students' complete understanding, regular use of modeling builds students' familiarity with skills they can use to understand the content. Over time, students develop habits for problem solving and critical thinking that are discipline specific. We know that historians, mathematicians, scientists, artists, and literary critics think differently from one another (Shanahan & Shanahan, 2008). Modeling is one of the ways that students are apprenticed into that type of thinking. When they hear history teachers, science teachers, English teachers, art teachers, coaches, mathematics teachers, and so on, share their thinking, students begin to develop an appreciation for the nuanced differences between content areas, which is essential if students are to develop their own expertise in a discipline.

Importantly, after adequate time in scaffolded instructional support that includes modeling, students should be able to complete tasks using the skill or strategy that was modeled for them. In other words, modeling gives students examples, not recipes, that they can follow as they complete their own work. PL

REFERENCES
