What Neuroscience Tells Us About Deepening Learning

By Wendi Pillars

http://www.edweek.org/tm/articles/2012/03/27/tln_pillars_neuroscience.html?tkn=TMNDabgYwtWPNoJX1JiaZCo%2Bugoho39OOjta&intc=bs&cmp=SOC-SHR-GEN#.T3RwzZ81O-c.blogger!

Teachers are brain-changers. As I've described in a **previous article**, our daily work physically alters students' neural networks. The more frequently a student's brain retrieves and connects information, the better the chance that the student will recall it quickly and accurately.

The strongest—and most easily accessible—memories are created through dense, interwoven neural networks. Information has a much better chance at being recalled more quickly when it has been retrieved repeatedly and connected to as many other pieces of information as possible.

However (and this has been a significant reflection point for me as an armchair neuroscientist) even a densely connected, sensory-rich memory is essentially reconstructed when it is recalled. The recalled information can be shaped by context, influenced by the student's emotional state, attention level, and receptivity.

As teachers, how can we help students forge long-term memories that will boost their future learning? Here are some of my take-aways:

Return to information over time. Strengthening long-term memory is not merely a matter of squirreling information away—but of returning to it and building upon it. It's a continual process rather than a linear one-stop experience.

This realization has led me to plan for pointed repetition and the accurate, explicit spiraling of information over time, particularly for my younger students and language learners. I plan weeks in advance to be more strategic about review and transitions. I also ask fewer "on-the-fly" questions, opting instead for higher-level questioning and opportunities to make connections from the start.

Graphic organizers are more tangible tools I use to encourage the repetitive synthesis of information that the relationship-seeking brain craves.

Slow down. When I ask a question, I now give students more "wait time" (well beyond the typical one to two seconds) so they have the opportunity for efficient, thorough memory reconstruction. This is especially critical for language learners who must translate their reconstructions to English.

And slowing down is especially important when I am trying to initiate topics by eliciting more than a cursory statement or two. At the start of a recent unit, I posed a challenging question, then gave students time to think, share, and make connections with each other. Within ten minutes, I

realized that students could already use about half of the "new" vocabulary I had chosen, and had answered nearly half of the anticipation guide questions. Thanks to those precious 10 minutes, I realized I needed to tweak the unit to improve its rigor and the interlinking of knowledge.

Time it right. Students tend to be best at recalling the first and last chunks of new information we share with them. Neuroscientists refer to this as the **primacy-recency effect**. New information presented first has the best chance of being recalled (due to primacy), while the last information presented has the next best chance of recall (due to recency). Those who study learning cycles also suggest that some sort of consolidation needs to occur about every 20 minutes or so.

What does this mean for us in the classroom?

Here's what I don't do during the first peak learning time: homework discussion, in-depth review, announcements, and attendance. (I save these for later in the class period.)

I try to ensure the first 10 minutes of class are extremely pointed, explicitly linked to the new lesson. Then students work on tasks that require application and exploration of this knowledge.

About 20 minutes into class, we take time for consolidation, to improve the chances that knowledge is as connected as possible. (This can be as simple as having students turn to a partner and repeat facts they have just learned.)

The last five or 10 minutes of class constitute the recency period, ripe for another dose of important information. I use that time for closure, asking students to synthesize information from the lesson.

Develop strong relationships with students. As mentioned above, memories are retrieved and reconstructed within one's current context. Research suggests that a student's recall of knowledge is determined in part by his or her current emotional state, learning level, attention, receptivity, and other factors.

Attending to the emotional states of our students can no longer be dismissed as too touchy-feely to consider—even by those of us who are self-professed tough-love advocates. The better we know our students, the more we can gauge behavior, beliefs, and feelings that can affect their ability to learn.

For example, short-term stress hormones such as adrenaline have shown positive effects on long-term semantic memory. But a student who is experiencing prolonged stress may have higher levels of cortisol, a hormone that can suppress long-term memory.

When I know my students well, I can recognize when they are under stress and provide appropriate scaffolding so they can experience some level of success even when challenged. For example, I might make sure the lesson includes novelty or prompts laughter to suppress the cortisol. I can also model a mindset that helps students control their own stress, prizing the development of ability rather than perfection of results.

Establish relevance. And of course, the better our relationships with students, the more effectively we can gauge their prior knowledge and what they truly understand. Then we can better help students relate to new information. We can discover their powerfully established neuronal networks, then "hitchhike" on these networks as we navigate the curriculum. James Zull states it succinctly in ***The Art of Changing the Brain***: "Prior knowledge is the beginning of new knowledge. It is always where learners start."

In other words, teachers may be brain-changers, but we must also give credence to the physical connections our students have already established! Too often, in the interest of expediency, I have assumed what students knew, then proceeded with "my" planning, "my" instruction, "my" connections, on "my" clock—when it should be about students' learning. In the past, I have struggled with frustration at what my students "don't get" or "don't know", when I should be celebrating what they do know and building upon that.

Slowing down (see tip #2!) helps with this. Rather than dismissing or glossing over seemingly random comments or "incorrect" responses, I give students time to explain. This has frequently showcased roundabout connections to students' previous learning and highlighted exactly where missed connections are. This means I can better influence how learning is bridged—and increase the chances it will be forged in long-term memory.

In the words of **Steven Levy**, teachers "need to look for the best, expect the best, find something in each child that we can truly treasure." Relationships—and the strategic investment of time—are critical aspects of mindful teaching.

The tips I've outlined here may seem obvious—indeed, effective teachers already practice them on a daily basis. The neuroscientific perspective can help us understand exactly why they are worthy of consistent implementation: to improve not only the recall of information but students' deeper understanding of our world.

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