Brain-based Research: BEST PRACTICES IN TEACHING

Learning is the acquisition of knowledge and skills and it requires memory so that our knowledge and skills are available to us when we need them.

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PART 1 ENRICHED LEARNING

We humans are born with about 100 billion nerve cells, or neurons. When we learn new information, the neurons fire to form new connections with other neurons. Over multiple firings, the neurons form neural networks with lasting connections. To describe this process, the Canadian neuropsychologist Donald Hebb declared in 1949, "Neurons that fire together, wire together." Or, as the adage goes, *Practice makes permanent.*

We also know that our neurons do not limit themselves to one connection. Rather, each neuron makes thousands of connections and connects to several different memories. Likewise, one memory exists in several neural networks. Our brains maintain vastly complex networks. To develop durable memory of our learning, we need multiple learning encounters that are relevant, multimodal, and enriched by thought and reflection. In other words, repetition—while necessary—is not sufficient.

This series of articles explains recent research in two domains of brain-based learning: Enriched Learning and Smart Practice. Each article suggests classroom practices so you can harness the strength of your students' minds.

RELEVANCE: BUILDING ON PRIOR KNOWLEDGE

> ***"There is virtually no limit to how much learning we can remember, as long as we relate to what we already know."***
>
> **— Brown, Roediger, McDaniel (2014)**

Learning is the process of making meaning by connecting new information to previous knowledge. If new learning does not relate to anything we already understand, we struggle to interpret it and give it meaning. In effect, the more a student knows, the more the student can learn (Brown 2014).

This has enormous implications for educators. Students with less background knowledge of a topic have a harder time making sense of new information. In various studies in the early 1990s, researchers determined that readers without background knowledge read more literally because they assume that all information comes from the text (Cromley 2000). Essential critical thinking skills — such as inferring and concluding — are not available to a reader who cannot supply the knowledge to "read between the lines." If our students are going to grow their knowledge and build critical thinking skills, we teachers need first to solidify a foundation of understanding upon

which to build. This can be achieved by simply starting a lesson asking students to share what they know about the topic. By dedicating some time to connect with students' knowledge we activate their schema, or neural network, and prime those neurons to fire new connections.

Another way to activate student schema is to pre-test students on the lesson content. Many teachers would not want to test their students on something they have not yet taught, but, according to research, knowing the answer may not be the most important part of learning. In 2009, a study determined that taking a pre-test before learning information increases learning by a dramatic 33%, even when students' initial answers are wrong. The theory is that considering a question before learning the answer activates students' learning schema. When students finally do learn the information, they experience that "aha" moment of understanding. (Richland, Kornell, Kao).

Research has also shown that at the end of class, teachers can underscore the connection between students' newly acquired knowledge to their lives outside of the classroom. In one study, researchers divided students into two groups. One group wrote a summary of the day's learning; the second group identified one way the day's learning related to their lives. At semester's end the students in the second group outperformed the students in the first (Zadina 2014).

Classroom Applications

As language teachers, we have the great advantage of teaching content that is immediately relevant to our students' lives, but as the above research indicates, we should take explicit steps to activate students' schema.

KWL

- **K-Know:** As you introduce a new topic, ask students what they already know about this topic. Have students write all the words they associate with the topic.
- **W-Want to learn:** Then ask students what more they want to learn about the topic. As you move through your lesson, make sure students are returning to those initial questions and trying to answer them with their new information.
- **L-Learned:** At the end of the lesson, ask students to summarize what they learned.

Before and After

- At the beginning of class, ask students a few questions they will be able to answer by the end of class.
- Have students write the questions and their first answers in their notebooks. Then have students fold the page so they don't return to the question immediately.
- At the end of class, tell students to go back to the questions and answer them again. Then have them discuss their answers in pairs.

Connections Inside and Out

Make sure students understand how the learning inside the classroom connects to their lives outside the classroom. You can make this connection explicit by brainstorming with students how they will use the learning in their daily lives. Ask:

- *Why are we learning this?*
- *When and where will you use this outside of class?*

MULTISENSORY LEARNING: ENRICHED ENCODING

> ***"Our senses are designed to work together, so when they are combined . . . the brain pays more attention and encodes the memory more robustly."***
>
> **— Medina (2014)**

In his popular book, *The Owner's Manual for the Brain*, Pierce Howard points out that our brains need variety: "Our sensory receptors become aroused when a new stimulus begins, but if the new stimulus continues without variation in quality or quantity, our sensory receptors shut down from their aroused state." (2006) We need to add novelty and variation for our neurons to fire until they wire.

Language, the focus of our teaching, is quite a brain-stimulating subject. Language activates many parts of the brain. In fact, different lobes of the brain specialize in processing different aspects of language (Zadina 2014). We process sound in a different location than we process visual information or motor information, so hearing the word *cat*, seeing the word *cat*, seeing a photograph of a *cat*, and saying the word *cat* all stimulate different parts of the brain. If we engage all these different senses, we are more likely to remember the meaning of *cat* because of the enriched experience of the concept of *cat* and number of pathways to that concept.

Study after study shows that memory improves when more than one sense is stimulated at the same time. The early pioneer in multimodal learning, Edgar Dale, found that people learn better from pictures and words than from words alone. In more recent years, Richard Mayer has established that learners who receive input in a variety

of senses have better recall than learners who receive only visual or auditory input. Hear a piece of information, and three days later we will remember 10% of it. Add a picture, and we will remember 65% (Medina 2014).

The ultimate expression of simultaneous and multimodal learning is *learning by doing*. When we learn by seeing and hearing, we remember 50% of it fourteen days later. But we remember 90% if we actually experience it (Dale 1969). This means that simulations, such as role plays, are very effective in helping students remember the new language they learned.

Within the four language skills of reading, writing, listening, and speaking, there is also a hierarchy of impact on memory. Reading and listening are receptive, and speaking and writing are expressive. When we reread material aloud (using an expressive pathway), our memory of that information is stronger than if we read it silently (using our receptive pathway). Colin MacLeod explains it as the *production effect* by which "saying a word aloud leads to better memory than does reading a word silently." (2013) While we cannot always prompt learning experiences that integrate all the senses, we should remember to give students many opportunities to use their expressive pathways in class. Invite them to speak, enunciate, discuss, print, write, type, and draw as much as possible.

Classroom Applications

Use as many sense modalities as possible to enrich students' learning and memory. This means using print in multiple typefaces and color, illustrations and photographs, tables and graphs, gesture and movement, audio, and video.

Multisensory Checklist

- To evaluate how many modalities you use in your classroom, complete the *Multisensory Checklist for Teaching Language:* http://teachertwoteacher.wordpress.com/2012/03/08/the-multisensory-checklist-for-teaching-language/.
- Plan ways to integrate some of your unchecked items into your teaching.
- Repeat the checklist every month, to stay aware of how you use modalities in your teaching.

Dramatic Dialogues

- Provide students with multiple exposures to a dialogue using a variety of media: audio, print, and video.
- Have students practice speaking the dialogue in a variety of ways: sitting, standing, with props, whispering, shouting, with gestures.
- Have students perform the dialogue in a role play. You can add many dimensions to their sensory learning by video-recording their role plays. Students can watch the videos and transcribe short sections.

Multisensory Spelling Practice

- **Sound:** Have students repeat a word and consider its number of syllables and syllable stress.
- **Print:** Have students look at the printed word and consider how the letters and the sounds correspond. Are there letters that are silent? Are there sounds that have no corresponding letters?
- **Movement:** Have students "write" the word on their desks with their index finger.

*Silent Read and Repeat**

This silent step allows students to focus on the mechanical aspects of pronunciation: the movements of lips, jaw, cheeks, and tongue.

- Read a line aloud to the class.
- Have students read it by mouthing the words (saying them with no voice).
- Have students then read the line aloud.

Additional links to multisensory teaching ideas:

http://teachertwoteacher.wordpress.com/2012/03/06/lets-get-physical-teaching-pronunciation/

http://teachertwoteacher.wordpress.com/2012/05/08/eight-great-reading-fluency-activities/

ELABORATION: THINKING ABOUT OUR LEARNING

> ***"If you're just engaging in mechanical repetition, it's true, you quickly hit the limit of what you can retain. However, if you practice elaboration, there's no known limit to how much you can learn."***
>
> **— Brown, Roediger, McDaniel (2014)**

Elaboration is the process of giving new material additional meaning by expressing it in your own words and connecting it with your previous experience and knowledge. Elaboration is a powerful step in the learning process; it activates the frontal lobe, engaging your capacity for critical thinking and self-awareness, and forces you to develop a deeper connection to your learning.

*Thanks to Marc Helgesen for this great idea!

As a class activity, elaboration is very easy to implement. It can be done individually, in pairs, or in groups and it can take many forms: retelling information; explaining material to a recently absent classmate; relating new material to situations in one's own life; writing an outline or summary of the new learning; organizing the new information in a graphic organizer; or applying the material to a new context in a role play. Elaboration activities have the additional advantage of requiring zero teacher-prep. Indeed, the key to elaboration is the student's effort. By finding the words to articulate, the student consolidates the learning.

Classroom Applications

End of Class Reflection

- Towards the end of each class, have students put away all their notes and books.
- Erase the board and then write the following question: *What did you learn in class today?*
- For three to five minutes, have students write their response. They cannot check their notes. They must try to retrieve the information from their own memory!
- Individually or in pairs, have students check their class notes for any omissions to their responses. Have students use a different color ink to write the information they failed to remember on their notes so they can pay special attention to that information when they study.

Retell and Reconstruct

- After reading a text or listening to a conversation, have students retell the information in pairs.
- Then have them work individually to reconstruct the text/conversation in writing.
- Have students read the text or listen to the conversation one more time (with their pencils down).
- Have them add any corrections or new details to the text in a different color ink.

Mark the Margins

- **Review Notes:** Towards the ends of class, have students review their class notes and mark their notes with the following symbols:

  ✓ I understand.

  ? I don't understand.

  \+ I want to practice more.

- **Record learning:** Before leaving class, have students write on a paper and hand in to you:

  One thing they learned.

  One question they have.

  One thing they want to practice more.

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