The Brain-Compatible Teaching and Learning Equation

Rod Haenke

We are just beginning to use our knowledge of the brain and how it works in the teaching and learning process. Eric Jensen, an expert on brain-based learning, said it this way: "We are on the verge of a revolution: the application of important new brain research to teaching and learning…. History will likely record that it began in the final two decades of the 20th century." (*Teaching with the Brain in Mind* by Eric Jensen, 1998)

So we are at the beginning stages of using what we know about how the brain works to impact teaching and learning in our classrooms. What should we do with this information? This article aims to synthesize some findings about the brain into a fairly simple-to-use formula or equation for teaching in brain-compatible ways or, as Jensen would say, "teaching with the brain in mind."

The Main Components of the Equation

Standards + Meaning + Patterning = Greater Learning

The brain-compatible teaching and learning equation consists of three main components: standards, meaning, and patterns. Standards form the foundation of what students should know and be able to do. This is what we are supposed to teach. However, brain research says that students really won't learn these standards unless we make them meaningful. And helping students make and see patterns with this new and meaningful information facilitates higher level thinking and, therefore, greater learning.

Teach Standards

We are in the midst of the standards movement in K-12 education: national standards, state standards, and state tests based on standards. Typically, private schools have emphasized "exceeding standards." The curriculum we use is developed to standards. We are taught to "teach to the objective." Let's not debate standards. They are here. They are important. They are the first component of the equation.

Facilitate Meaning

In order for students to learn well, we must go beyond simply teaching to the standards. We must create meaning. As Jensen states, "Many of our deeply felt meanings in life are built in, sort of hard wired into our brains." There are specific ways, brain researchers tell us, that we can teach to facilitate this "hard wiring." Think of something you learned that is hard wired into your brain. Why is this so? What made it meaningful? This is why the second component is to facilitate meaning—we want what we teach to become hard wired.

Utilize Patterns

It is an oversimplification to say that the brain's main job is to create patterns. However, Andrew Coward, author of *Pattern Thinking*, says the brain "forms quick hierarchies to extract or create patterns." Jensen says that "pattern making may be innate" and that we "not only are naturals at learning pattern discrimination but at applying it to other models." Pat Wolfe says

> Neural networks "check out" sensory stimuli as soon as they enter the brain to see if they form a familiar pattern. If they do, a match occurs, and the brain determines

that the new visual stimuli are familiar. In this case, we could say that the new information makes sense or has meaning. What happens if there is no match? The brain may attend to the meaningless information for a short period of time because it is novel; but if it can make no sense out of the incoming stimuli, the brain will probably not process them further.

As teachers, our job is to help make matches. One way to do this is to use graphic organizers that mimic the brain's ability to form patterns and make sense of what we are teaching.

Brain-Based Learning Tools

Following are some easy-to-use tools to integrate the equation in your teaching. Using these tools will help you develop more powerful and brain compatible lessons and will provide you with a checklist of things to consider when teaching almost anything in ways that coincide with how the brain works. The following lesson plan format, the "making meaning" techniques, and the graphic organizer examples can be used regularly to make almost any content more focused, more meaningful, and more digestible by the human brain.

Lesson Plan Format

Use a lesson plan format that can quickly help you tie standards, meaning, and patterns together. The following elements make up the format:

- Standard/Objective: Like most lesson plan templates, start with the student learning objective.

- Meaning Maker: Specify how you are going to make the learning meaningful to your students.
- Facilitating Patterns: Describe how you will use graphic organizers in your lesson to hard wire the learning.

Making Meaning

The following techniques are based on a synthesis of brain research and the ideas of experts such as Pat Wolfe and Jensen about helping students make brain connections to what is being taught. (An example is provided using a fairly mundane learning objective in order to demonstrate each suggestion.) You can use these techniques to stimulate ideas for teaching content and skills in ways that are more meaningful to students.

- Pose the appropriate level of challenge and provide frequent feedback for an enriching learning experience. How could the learning of this concept or skill be enhanced through a challenging problem-solving situation? How could you give students timely and instructive feedback as they progress though the problem? For example, instead of saying, "Today we are going to learn how to add two-digit numbers," say, "Can you think of three ways to add 34 + 47?" As students progress through though the problem, provide encouragement for their thinking. Give them specific feedback such as "oh, so you figured out that you could add 30 + 40 first." Also, build in opportunities for them to explain their thinking to each other.

- Tap into students' needs and goals to utilize intrinsic motivation. How would learning about this concept or skill affect your students' life right now or in the future? For example, when do

students need to be able to add two-digit numbers? (Suggestions: adding points in games, combining money for buying candy or toys, calculating points in fantasy football, and figuring out how many days until summer vacation.) Have them think of situations and use those as student-developed word problems.

- Tap into students' emotions through stories, drama, and characters to enhance learning. What books, stories, movies, or characters can you think of that have the potential to touch emotions and motivate learning about this concept or skill? What experiences from your life, your students' lives, or other people's lives can create an emotional connection to this concept or topic? For example, use the book *The Math Curse* by Jon Scieszka to introduce a lesson on two-digit addition. This can stimulate students' thinking about real-life connections.

- Provide choices to reduce student stress and increase intrinsic motivation. How could you present choices within the context of learning about this concept or skill? For example, you could present the students with three ways to add two-digit numbers. Have them practice with whatever method they choose.

- Be purposeful about connecting physical movement, the arts, and fun. How could you have the students use their bodies to interact with the concept or skill? How could they role-play the concept or skill? How could you use a familiar game like charades or Simon Says to learn the concept or skill? For example, students could use "steps" to estimate the length of familiar items and use mental addition. "The distance from my desk to the door is eight steps." They could then

measure how long their step is and mentally add or multiply. Or they could play Simon Says: "Simon says add 34 + 47."

- Tie into students' past successes and experiences to help students connect to prior learning or knowledge and to enhance their self-esteem. How can they leverage what they've learned or done in the past in their exploration of this concept or skill? For example, if students have mastered basic facts such as 4 + 7, ask, "How is adding 34 + 47 like adding 4 + 7?"

- Connect what is being taught to current events to make the learning relevant to students. What is going on globally, nationally, and locally that can make the learning of this concept or skill relevant? For example, have the students look at the Electoral College vote counts from this fall's presidential election. Do the results of the popular vote match those of the electoral vote? What shifts in the electoral vote could have altered the result of the election?

- According to Pat Wolfe, actual experiences where students solve real problems or produce a real product can make the "strongest neural networks" in our brains. What real problem or project could we come up with that will require learning this concept or skill? For example, the students could plan a summer vacation across the United States including tour stops every 200 miles or so. They would have to be able to add mileage segments to determine where to stop. You could also plan a local field trip for the school or your grade and calculate the number of buses that would be needed to carry the students. As students get older, the problems can become more complicated and more real.

Graphic Organizers that Facilitate Pattern Making

According to Gerard I. Nierenberg, author of *The Art of Creative Thinking*, children use three key skills when processing new information and creating mental patterns: they order it, they structure it, and they relate to it. This is enhanced when children demonstrate two additional skills: the ability to interchange these patterns and the ability to change the levels of these patterns. Here's how Nierenberg describes each of these skills:

Order

> Order deals with change in time and space (growth, transformation, development, evolution). (Nierenberg)

Questions that help us understand how to think about **order** when teaching concepts or skills are:

- What are the phases or steps related to the concept or skill being taught?
- Can this concept or skill be expanded or diminished?
- Are cause-and-effect interactions related to this concept or skill?

Graphic organizers that can help students see **order** are:

- A flow chart shows the steps involved.
- A cycle shows a repeating pattern of steps.
- An episode pattern organizer shows cause and effect of a series of events.
- A timeline sequences events.

• A web diagram or bubble chart shows how the concept or skill can be expanded upon or diminished.

• Circular arrows show continual sequencing.

• Concentric circles show how one concept builds on another.

• A pyramid shows a sequence of importance.

Structure

The term *structure* implies that everything in the world that we view is unique and different. No two things examined in great detail are exactly the same. (Nierenberg)

Questions that help us understand how to think about **structure** when teaching concepts or skills are:

• What elements make up the concept?

• What does it consist of?

• How is this concept different from other concepts?

• How can it be sorted separately from other concepts?

• How is its shape, substance, size, or effect different from other concepts?

Graphic organizers that can help students see **structure** are:

• A fish diagram can help students see how the structure of a story is distinct.

• A radial diagram can show categorical distinctions of any concept.

• A picture diagram can show the key elements of a concept.

Relation

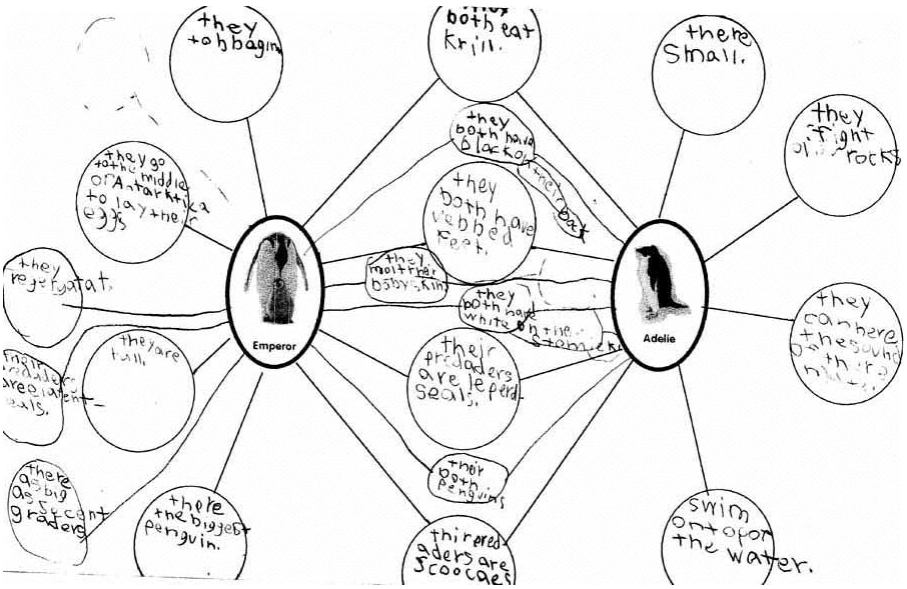
The term *relation* implies that, in spite of the basic understanding of differences, we use the skill of relation to observe and respond as well to similarities. (Nierenberg)

Questions that can help us understand how to think about **relation** when teaching concepts or skills are:

- How is this concept similar to another concept?
- What is its class or category?
- What is it a part of that is related? What are its related parts?

Graphic organizers that can help students see **relation** are:

- An organization chart can show how two concepts are related.
- A Venn diagram can show the similarities and differences of two or three concepts.
- A double bubble map also shows similarities and differences between two concepts.



The Equation in Action

Here's a sampling of ways to use the equation to work on reading comprehension. The teacher used a high interest topic—the local baseball team (the Minnesota Twins)—to help make meaning; and had students use technology to make graphic organizers to help develop patterns of thinking around the text. Use this example to stimulate your own ideas for using the equation to improve learning for your students.

Standard/Objective

Students will demonstrate comprehension of a series of related newspaper articles. (The teacher cut out a series of stories from the Minn*eapolis Star Tribune* on the struggles the Minnesota Twins were having in the beginning of the 2004 season.)

Meaning Makers

• Current events connection (used a series of newspaper stories from the *Minneapolis Star Tribune*).

• Some students are intrinsically motivated to learn about their favorite baseball team (Minnesota Twins).

• Some students play sports and can relate to the injuries of baseball players.

Facilitating Patterns

• Picture diagram (made with PowerPoint graphics) helps students comprehend vocabulary (structure).

• Cycle (made with PowerPoint template) shows a sequence of events (order).

- Pyramid (made with PowerPoint template) shows cause and effect (order).
- Organization chart (using PowerPoint template) shows how two concepts are related to an overall concept (order).
- Venn diagram (using PowerPoint template) shows how three concepts contribute to an overall concept (relation).
- Concentric circles (using PowerPoint graphics) shows how four concepts build on one another (relation).
- Radial diagram (using PowerPoint template) shows key elements of a concept (structure).
- Flow chart shows key sequence of events (order).
- Episode pattern organizer (using Excel spreadsheet) shows cause and effect of a key series of events (relation).
- Timeline table (using Excel spreadsheet) shows key sequence of events (order) and a way for students to demonstrate connections to what was read.

This article shared practical suggestions for designing more brain-compatible lessons. Teaching to the standards doesn't have to mean that we are abandoning critical thinking skills and that we are disposing of depth for breadth. In fact, using the "Brain-Compatible Teaching and Learning Equation" provides a way for you to make the learning the standards more meaningful for your students and provides opportunities for you to facilitate greater learning by facilitating the brain's natural tendency to want to create patterns with new information.

Resources

Teaching with the Brain in Mind, by Eric Jensen (ASCD, 1998)

Brain Matters: Translating Research into Classroom Practice, by Patricia Wolfe (ASCD, 2001)

The Art of Creative Thinking, by Gerard I. Nierenberg (Barnes and Noble Books, 1982)

Pattern Thinking, by L. Andrew Coward (Greenwood Publishing Group, 1990)

Math Curse, by Jon Scieszka and illustrated by Lane Smith (Viking, 1995)

ASCD Newsletter on Brain-based Education (contact Wayne Jennings at **wayne@designlearn.com**)

Caine Learning: www.cainelearning.com

Jensen Learning Corporation: www.jlcbrain.com

Graphic Organizers: www.eduplace.com/graphicorganizer

SCORE Graphic Organizers: www.sdcoe.k12.ca.us/score/actbank/torganiz.htm

Discussion Questions

1. Think of something you learned that had a great deal of meaning tied to it. What made it meaningful?
2. What is the most important thing you are going to teach today? How has it changed over time? What is its unique structure? How is it different than anything else you will teach? How is it similar to other things you teach?
3. How can you use graphic organizers to regularly assess your students' prior knowledge?
4. Think of the most challenging concepts that you teach. How can you use structure, order, and relation to help students better understand those concepts?

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