For the Success of Each Learner

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How Teachers Are Putting Brain Research to Use

John Franklin

In 1908, Henry Ford introduced the world to the first Model T automobile. Weighing 1,200 pounds, the car boasted a top cruising speed of 60 miles per hour and cost just $850. Today's automobiles bear little resemblance to their ancestor, but the innovations that drove the manufacture, design, and refinement of the Model T continued to shape the auto industry for decades.

Much like the early days of the automobile, brain research is currently in its initial stages. But researchers predict that just as those early mechanical innovations influenced auto development for years after, the brain research findings of today will eventually give rise to sweeping changes in education in general and instruction in particular. “We're all driving Model Ts right now when it comes to brain research,” says Joan Caulfield, cofacilitator of ASCD's Brain-Compatible Learning Network and coauthor of the book *Bridging the Learning/Assessment Gap: Showcase Teaching*. “We're still just in the early stages of understanding all these new and wonderful things we're learning.”

Studying how the brain operates may offer insight into students' thinking and understanding, but translating that knowledge into practical strategies and lesson plans remains exploratory territory for many educators. Furthermore, like proverbial snowflakes, no two brains are alike. “Every brain is unique,” says Wayne Jennings, Caulfield's coauthor and fellow network facilitator. “This complicates the picture for teachers, because just as every brain is unique, every learner is unique. Some children work well alone, some better with partners or in groups, some in low light, and others in bright light. There are many differences in learning styles.”

Faced with this variety of learning styles, many teachers seek not only to learn more about how the brain develops and operates but also to find ways of applying what is known to make

teaching more effective. “We compare this to what an artist does when painting,” says Caulfield. “Just as you need to have a palette of many different colors to paint a picture, you need different strategies to meet different students' needs—and teachers are always hungry for strategies that can help them revolutionize their classrooms.”

Keeping Up with Research

Until recently, much of the information shared with teachers and educators about how the brain works has been scientific in nature, with little emphasis on practical application. Teachers may now have an understanding of how the brain grows and changes, for example, but they don't necessarily know how to translate that information into successful instruction.

The rapid pace of research further complicates the situation. “Brain research is proliferating so quickly that we can hardly keep up with it,” confesses Pat Wolfe, an educational consultant specializing in brain issues and author of the ASCD book *Brain Matters: Translating Research into Classroom Practice*. “Much of what we know is not set in stone yet.”

What *is* known is that although the brain continues to grow and change throughout a person's life, it goes through various critical formative stages of development during the K–12 years. In the early years, children expand their understanding of the world around them, storing the sights, smells, and tastes of various stimuli while learning about their environments and their relationships with peers. As a result of these experiences, their brains form millions of connections. At about age 2, however, their brains begin to “prune” many of the excess connections in order to become more efficient.

Then, at the beginning of adolescence—usually around 10 or 11—the brain engages in a second pruning phase, again whittling away and finetuning cells, mainly in the frontal lobes, which are responsible for higher-level thinking and problem solving. This pruning process continues until the early 20s, when the brain has largely completed its transformation into the organ it will become throughout adulthood.

Recognizing these developmental stages and tailoring instruction accordingly to maximize students' abilities can make learning more relevant and lasting for students.

The Early Years

For very young children, experts recommend using specific kinds of activities to stimulate brain development. Rather than lining up desks and giving presentations from the front of the classroom, for instance, teachers might emphasize kinesthetics and physical components to help children associate concepts with activities.

“One elementary teacher I knew taught a lesson plan about the heart and circulatory system by getting red and blue ribbon and having the class move to the gym,” says Connie Kieffer, an assistant professor of education at the National Louis University in Wheeling, Ill. The students

took the ribbons and formed lines representing the paths to and from the heart to see where and how blood flowed through the body. By having physical activity incorporated into the lesson, the students were better able to visualize the process and understand it. “Involving kids kinesthetically is important,” Kieffer notes. “They remember things because they've done them physically.”

Physical activities that support learning don't necessarily require cordoning off the school gym. Visual interpretation and individual activity can also help impart knowledge to young students. For example, children can draw or observe items that can then be incorporated into lesson plans. “Look at the food chain,” Kieffer says. “Children take images of animals and plants and move them into different positions to follow the path of the chain.” A plant, for instance, might grow until it is eaten by a gazelle, which in turn is eventually eaten by a lion. When the lion dies, its body decomposes and supplies nutrients to the soil, enabling more plants to grow. Depicting this cycle through such activities enables children to “physically and visually re-create the food chain,” Kieffer says. This, in turn, helps them better retain the information.

By ensuring that lesson plans are unique and stimulating, teachers can make classroom experiences meaningful and memorable for students. “If we have a vocabulary exercise, I try to make a game out of it,” says Sharon Salpas, a resource specialist in Redding, Calif. “We might do word association, a memory game, or some other kind of activity that helps make the experience more novel and connects it in meaningful ways that they can relate to.”

Meeting in the Middle

Making meaningful connections is helpful not only for elementary school children, learning experts say, but also for older students. Tying instruction to the world beyond the classroom helps students see how what they are studying applies to their everyday lives. These connections provide countless opportunities for reinforcing what they learn.

“Let's say you have a geometry lesson,” says Renate Caine, a professor of education at California State University in San Bernardino. “A teacher might put a diagram on a chalkboard, explain how the sides and corners relate, and students will copy it into their notebooks.” Although this mode of instruction may work for some students, Caine asserts that a better method would be to challenge the students to find examples of the shapes and angles around the school. Student teams could explore the surrounding schoolyard and look for parallel lines, angles, oblong shapes, and other geometric symbols that they pass every day going to or from school. Furthermore, the use of teams injects the exercise with a social element that also helps students' minds grow. “Remember, the mind is social,” Caine says. “You're embedding this knowledge in their experiences and everyday worlds.”

As students age, embedding knowledge requires giving them more choices in their learning. “A lot of students get more out of school if they are given choices as to how they want to learn

something," Kieffer says. "If they're more interested in it, they'll do more work and have more of a desire to learn."

Kieffer cites one method that involves a game reminiscent of tic-tac-toe. A middle school teacher takes a novel, such as Sandra Cisneros's *House on Mango Street*, and outlines nine different options from which students can choose to demonstrate their understanding of the story. Students must complete any three options in a row, and each row allows them to choose the types of activities they feel most comfortable using. "Each row will involve something kinesthetic, something visual, and something written," Kieffer explains. Students can create cartoon strips that outline the story, or they might construct a model house based on the house in the novel. "You're giving kids choices and giving them a chance to address their senses and learning styles," Kieffer points out. "That's brain-friendly, but hopefully it's fun, too."

Wanted: Great Singing Voice

The need to have fun and enjoy learning is something that the brain never outgrows, expert say. Although in most cases brain development is essentially complete by age 20, the use of music can resonate with learners of all ages.

Eric Jensen, well-known brain researcher and author of the ASCD book *Teaching with the Brain in Mind*, confirms the effectiveness of using music as an instructional tool with students of any age. Just because students are older, Jensen says, "you shouldn't throw away the good things you do in elementary school."

Some teachers set their lesson plans to music to help students learn. A quick search of the Internet, for instance, reveals that mathematics teachers have set the components of the quadratic equation $[-b \pm \sqrt{(b2-4ac)}]/2a$ to any number of common children's songs, including "Mary Had a Little Lamb," "Pop Goes the Weasel," "Take Me Out to the Ballgame," and even "Freré Jacques."

College professors also experiment with instructional techniques that employ music, sometimes with humorous results. "One college professor I know of composes songs for his physics students," says Jensen. "He brought in his banjo one day, and he used it to explain complicated theorems." The students found the presentation so entertaining that the professor asked his wife—also a musician—to help him compose enough songs to outline the concepts and theorems of his classes for the entire semester. "He's now known as the 'Singing Professor,'" Jensen says. "And the kids beat a path to his class every year."

Conclusively Inconclusive

Though brain-friendly strategies can help educators craft successful learning activities, experts are quick to caution that much of the research on the brain and learning is not yet considered scientifically definitive. "You need to take what you hear about the brain with a grain of salt,"

Wolfe says. “Not all neuroscientists agree. Brain research doesn't prove things; it's up to us as educators to work in that laboratory called the classroom to take the research and interpret it for our use.”

According to Caine, successful implementation of brain-friendly strategies requires three primary classroom conditions:

- **Relaxed alertness.** “When students are in a good environment, they feel good. If they feel challenged, they'll go for answers. You need to create an optimal environment with the right conditions for learning.” Lighting, atmosphere, and surroundings should convey messages of safety and commitment to learning at all times.
- **Immersion in complex experiences.** “The brain is meant to learn from experience.” A stable environment with lots of stimuli helps students feel comfortable experiencing a variety of challenges that can help them grow.
- **Active processing of experiences.** Teachers must challenge students to analyze their experiences and use their knowledge out in the world. Common themes should be linked throughout lesson plans to build a solid foundation for students as they learn.

Above all, researchers say, students must be able to review and, where applicable, repeat concepts in order to incorporate them into their everyday lives. As students learn, their minds change and grow, giving them invaluable tools for the future. “A study shows that people who drive longer, such as taxi drivers, have larger hippocampi than people who do not,” says Caine. “By doing things in a repetitive way and experiencing them directly, you alter your brain. When those changes are used and incorporated, you see the academic knowledge and natural knowledge come together in a child's mind. You see kids get engaged and see them want to find things out about their world—and that's when real changes start to happen.”
