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Educators Seek to Apply Brain Research

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Learning has always been “brain-based”—by necessity—but understanding exactly how educators interact with the brains of their students has been largely a matter of guesswork. Although the brain's operation is still far from completely understood, technological advances in recent years have allowed scientists literally to see how the brain works, in ways previously unimagined. One result is a new wave of attempts to put brain research to use in the classroom.

“Teachers basically have a functional understanding of the brain, but they don't have a biological understanding of the brain,” says Robert Sylwester, author of the new ASCD book *A Celebration of Neurons: An Educator's Guide to the Human Brain*. “When you start to get a biological understanding, you can begin to say, `Oh, *this* is why this works.'”

Interpreting brain research to derive its implications for education is complicated, however. “It isn't like brain research says cooperative learning is a good thing,” Sylwester cautions. “Brain research doesn't prove that portfolio assessment is a good thing. But a lot of indicators that are emerging out of brain research suggest why it works.” To make those connections, educators need to be familiar with the basic workings of the brain, experts say.

For educators to keep up with an exploding and highly technical field is impossible, says Paul Grobstein, a professor of biology at Bryn Mawr College, who runs an annual institute for K-12 teachers on recent brain research. However, “knowing something about how the brain works in general, and something of how [scientists have] come to these understandings, is easier and quite useful,” he adds.

As the cognitive sciences produce more findings that are relevant to education, educators without basic knowledge risk being misled by dubious or unfounded claims, Sylwester believes. “You have a profession of two million teachers, only a small percentage of whom know the language of the cognitive sciences,” he says. “They're intimidated by the technology, and by the method of study.” Yet the relationship between scientists and educators should be collaborative, he urges. “They need us and we need them.”

Classroom Implications

Implications from brain research for educators range from the general to the specific. Sylwester offers examples of recent discoveries that have specific implications for educators:

- Learning to read requires a child to develop new connections between brain regions that process oral versus written language. Those connections may grow to be more efficient if early reading instruction moves as quickly

as possible to normal processing rates, rather than lingering at slower, apparently easier rates.
- Children develop strategies for doing arithmetic problems very early (such as finger counting, or counting up from the larger of two addends). They learn a new strategy best when they are presented with problems that fit the strategy.

This technique works better than waiting until children reach an impasse with their current strategy, suggesting that instructors should teach various arithmetic strategies and show students how to self-monitor the use of these strategies in problem solving.

Both of these findings follow from a growing understanding of brain *plasticity*, or the brain's ability to grow and adapt in response to environmental stimuli. Researchers see the brain as genetically prepared at birth to learn almost anything, Sylwester says. The brain then uses “emotion, experience, and learning to strengthen the useful connections, and then prune away the unused and inefficient.” Some plasticity remains throughout life, allowing the brain to continue adapting. In other words, the physiological architecture of the brain changes in response to life experience.

The finding of plasticity, and the growing understanding that brain activities are linked by networks of neurons that perform many operations at once, suggests that education should broaden its scope to integrate the entire school experience into the learning program. “We know that when we teach children how to read, years down the road they are better at doing abstract thinking. So we're never doing just one thing,” says Renate Caine, coauthor of *Making Connections: Teaching and the Human Brain*. The complexity of the brain's learning means that educators should “orchestrate complex experiences,” she believes. “This is where the gap is. It's between the holistic or complex view of learning, and the more specific, direct-intervention type of approach.”

Although some educators choose to focus narrowly on disciplinary subjects in the hope that students will accumulate facts and skills, Caine says, the complex experience method is more effective. “That means that the children have hands-on experience. They have the potential to engage in dialogue with other people. They have the opportunity to express something orally, the opportunity to express something in written form, the opportunity to touch, to recreate.”

Interdisciplinary instruction is a centerpiece of brain-based education reform, proponents contend. “What has to go are the curriculum pieces we've clung to for centuries,” says Susan Kovalik, an education consultant and developer of the Integrated Thematic Instruction model. “Disciplines have to go; the textbooks have to go; the worksheets have to go—because they have nothing to do with how the brain works.”

Carol Lawrence, an English and history teacher at Park View Middle School in Yucaipa, Calif., uses thematic projects in her brain-based teaching. She works with students to define the direction of study and goes into depth on each subject. “I've always felt that you have to have meaning in what you're doing,” she says. “You have to provide opportunities for students to make connections with their own life experiences. It's something that I've always used in my teaching, but I just did it—I didn't know *why* I did it.”

Grobstein has found that teachers who look at behavior “from the inside, in terms of nervous system structure and function,” have a perspective that includes “an appreciation of the genuine distinctiveness of individuals who have different but equally valid ways of doing things,” and “an awareness of the complex interplay of a variety of factors in causing behavior.” Underlying effective learning, he notes, is the “strong motivation to create and make sense of things.” What teachers who study the brain learn usually does not surprise them, he adds. Yet “even teachers who recognize many of these elements from their own experience find it useful to see them in their relations to one another, and as principles with a justification beyond their own experiences.”

Gareth Montgomery, who also teaches at Park View Middle School, concurs. “Becoming more cognizant of how we learn helps us bring the most out of each child, or helps them bring the most out of themselves,” she says. “It also helps us not accept as many excuses, because we know that all students can learn, regardless of what tag has been put on them.”

Emotion and Attention

As an evolving species, human beings developed a remarkable ability to recognize patterns and respond to changing conditions to survive. “We have deeply embedded, innate systems that cull out of the environment those things that are either dangerous or helpful to us,” Sylwester says. These systems, however, are “quite primal.” We use our emotions to determine what is important to learn and remember. “Emotion drives attention, and attention drives learning and memory. You're not going to learn anything if you're not paying attention to it. Our attentional system determines what is important, and you never remember anything if it's not important.”

Kovalik agrees. “The brain stores information based on functionality,” she says. “We're a species that's been around four million years. Our species hasn't survived by taking in a lot of stuff that didn't have meaning to us. So it has to have meaning to the students, and it has to have functionality.”

Although the implications of brain research for education cut against the grain of many traditional school practices, they are in line with some current reform efforts, experts agree. “The cognitive sciences are discovering all sorts of things that good teachers have always intuitively known,” Sylwester says. “What's important, however, is that our profession is now getting strong support for many practices that our critics have decried.” For example, educators can

now argue that the tendency of the brain to consider the entire experience, and to search for meaningful patterns, calls for thematic instruction.

Sylwester believes that scientific support is important in promoting such “inefficient” advances as cooperative learning, portfolio assessment, and thematic curriculum. “These are all things that teachers have come up with, and kids like them, and we like to do them, but it costs more money to do these things.”

Learning to apply brain research in the classroom can also make teaching more meaningful for teachers, Lawrence says. After teaching for 27 years, she feels professionally “rejuvenated” by her application of brain research in the classroom in the last four years. “After this long in teaching, instead of wanting to retire, I'm excited about what I'm doing. I'm excited to be here every day.”

ASCD Resources

A Celebration of Neurons: An Educator's Guide to the Human Brain, by Robert Sylwester (1995). Stock no. 1-95085. Price: $15.95.

Making Connections: Teaching and the Human Brain, by Renate Nummela Caine and Geoffrey Caine (1991). Stock no. 3-94176. Price: $17.95.

For more information or to submit an order, contact ASCD Order Processing, 1250 N. Pitt St., Alexandria, VA 22314; (703) 549-9110. Please add $2.50 to all orders for handling. Postage on prepaid orders is free.