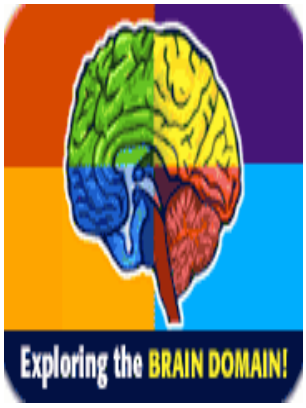
Growing Bigger Brains: Research Affects How Teachers Teach

"To enhance public awareness of the benefits to be derived from brain research," Congress designated the 1990s as the Decade of the Brain. Now, Education World takes a look at the results of some of the decade's brain research and explores the implications for you and your students.



According to Ronald Kotulak, the author of *Learning How to Use the Brain*, scientists learned more about the brain during the last decade than they learned during the entire century preceding it. So if you've been out of school for even five or ten years, chances are that much of what you learned about how the brain develops and functions is obsolete. Does it matter? Take a look at some of the latest research and find out.

MAKING CONNECTIONS

According to brain researchers, the human brain contains billions of nerve cells, or neurons, that receive, process, and transmit information. Dendrites, tentacle-like branches of the nerve cells, provide the receptive surfaces of those cells, creating connections between neurons and transmitting information from one to another.

For many years, most scientists believed that each person was born with a certain number of brain cells and, therefore, a genetically predetermined intellectual capacity. The most recent research, however, appears to refute some of those assumptions. Brain Research and Education: Neuroscience Research Has Impact for Education Policy, an Education Commission of the States (ECS) report, states, "Research shows [that] much of the "wiring" of the brain's neurons comes after birth and depends on the experiences infants and children have." In other words, the brain is formed, at least in part, by the environment.

Marian Diamond, a neuroscientist at the University of California at Berkeley, conducted experiments on rats to learn about the effects of environment on neurons, dendrites, and intelligence. She found the following:

- Rats raised in an enriched environment with opportunities for socialization and many sensory experiences grew more dendrites in the cerebral cortex -- the part of the brain where higher thinking occurs -- and demonstrated greater ability to negotiate mazes than did rats raised in an impoverished environment.

- Rats that could observe but not participate in an enriched environment developed fewer changes in the cerebral cortex and demonstrated less intelligence than did the rats that actively participated.
- Rats that were provided with a great number of enrichment experiences at the same time became overstimulated and developed fewer changes in the cerebral cortex than did rats that experienced an enrichment environment spread out over time.

Diamond's experiments, and similar experiments by other scientists, indicate that brains are not rigid at birth, but plastic -- "having the ability to change structure and chemistry in response to the environment." That plasticity, researchers say, means that intelligence is at least partially determined by environment, and by other factors, such as nutrition, prior learning, life experiences, and even beliefs and values. Although scientists still believe that (for the most part) humans cannot grow new neurons, they now believe that the brain can and does grow new dendrites -- the connections between neurons that create memory and learning. The number and efficiency of dendrites, neuroscientists say, determine how much -- and how well -- the brain receives, processes, and retains information. "Intelligence," said Diamond, "depends on the connections among the nerve cells." And those connections depend, at least in part, on the quality of the educational environment.

NEW VIEWS OF THE BRAIN

So what part of the research can be applied to your students and your classroom? Educators who follow and interpret brain research at the North Coast Professional Development Consortium have developed The Twelve Principles for Brain-Based Learning to help teachers organize and make sense of the data. The principles follow:

1. The brain is a parallel processor in which thoughts, experiences, and emotions operate simultaneously.
2. Learning engages the entire physiology.
3. The search for meaning is innate.
4. The search for meaning occurs through patterning.
5. Emotions are critical to patterning.
6. Every brain simultaneously perceives and creates wholes and parts.
7. Learning involves both focused attention and peripheral perception.
8. Learning always involves conscious and unconscious processes.

9. The brain uses at least two types of memory -- a spatial memory and a set of systems for rote learning.
10. The brain understands and remembers best when facts and skills are embedded in natural spatial memory.
11. Learning is enhanced by challenge and inhibited by threat.
12. Each brain is unique.

WHAT CAN A CLASSROOM TEACHER DO?

In *Is the Fuss About Brain Research Justified?*, David Sousa, an educational consultant, presented an interpretation of how the latest brain research might influence educational practice. He provides the following recommendations based on research.

- A stimulating environment creates more connections in the brain, so teachers must take advantage of the windows of opportunity that occur in children between the ages of 2 and 11 by providing an enriched and challenging educational environment. *Windows of opportunity* are critical periods in the brain's development, when the brain is most susceptible to input and most receptive to establishing neural connections that foster memory and learning.
- The brain makes the most neural connections when it is actively involved in learning, therefore, learning should be multisensory and interactive.
- Activities that involve emotion trigger the release of chemicals in the brain that strengthen memory, so learning must be made meaningful to each student.
- The human brain strives to create connections or patterns, so learning should build on prior knowledge.
- The brain's hierarchy of tasks starts with physical survival, moves to emotional survival, and only then turns to thinking and learning; students must feel physically safe and emotionally secure before they can learn.
- The brains of today's students are accustomed to rapidly changing environmental stimuli, therefore, short learning periods are more effective than long ones.

Perhaps the most important thing to remember, however, is that the research shows that each brain is unique. The most effective teachers, therefore, provide many opportunities for enrichment and implement a variety of instructional strategies. Those strategies are most relevant and most successful when teachers base their efforts on what researchers have discovered about the brain. Sousa, a strong advocate for the educational application of brain research, believes that school

administrators have a responsibility to provide educators with opportunities for studying and assessing that research. "Educators," he said, "must acquire a more scientific understanding of the brain before they can determine the educational applications of the research."

Sousa added: "We need programs that give all prospective and current teachers a working knowledge of brain growth and development and that include frequent contacts with cognitive researchers to keep abreast of relevant research findings. With such a long-term commitment, teachers will have the competence to determine which classroom strategies are more compatible with the current understanding of today's brain."

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