Understanding a Brain-Based Approach to Learning and Teaching

Educators who become aware of recent research on how the brain learns will gain exciting ideas about conditions and environments that can optimize learning.

The greatest challenge of brain research for educators does not lie in understanding the anatomical intricacies of brain functioning but in comprehending the vastness, complexity, and potential of the human brain. What we are beginning to discover about the role of emotions, stress, and threat in learning and about memory systems and motivation is challenging basic assumptions about traditional education. Fully understood, this information requires a major shift in our definitions of testing and grading and in the organizational structure of classrooms and schools.

Principles for Brain-Based Learning

We offer the following brain principles as a general theoretical foundation for brain-based learning. These principles are simple and neurologically sound. Applied to education, however, they help us to reconceptualize teaching by taking us out of traditional frames of reference and guiding us in defining and selecting appropriate programs and methodologies.

Principle One: The Brain Is a Parallel Processor

The brain ceaselessly performs many functions simultaneously (Ornstein and Thompson 1984). Thoughts, emotions, imagination, and predispositions operate concurrently. They interact with other brain processes such as health maintenance and the expansion of general social and cultural knowledge.

Implications for education: Like the brain, good teaching should "orchestrate" all the dimensions of parallel processing, and it must be based on theories and methodologies that make such orchestration possible. As no one method or technique can by itself adequately encompass the variations of the human brain, teachers need a frame of reference that enables them to select from the vast array of methods and approaches that are available.

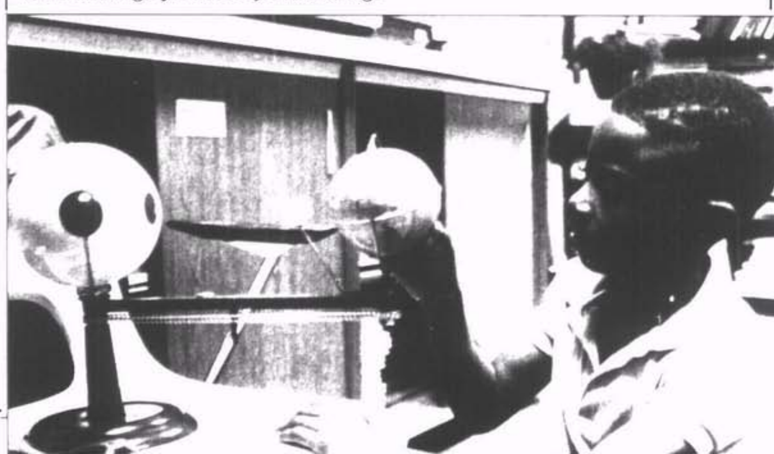
Principle Two: Learning Engages the Entire Physiology

Like the heart, liver, or lungs, the brain is an incredibly complex physiological organ functioning according to physiological rules. Learning is as natural as breathing, and it is possible to either inhibit or facilitate it. Neuron growth, nourishment, and synaptic interactions are integrally related to the perception and interpretation of experiences (Diamond 1985). Stress and threat affect the brain, and it is influenced differently by peace, challenge, boredom, happiness, and contentment (Ornstein and Sobel 1987). In fact, the actual "wiring" of the brain is affected by school and life experiences. Anything that affects our physiological functioning affects our capacity to learn.

Implications for education: Brain-based teaching must fully incorporate stress management, nutrition, exercise, drug education, and other facets of health into the learning process. Learning is influenced by the natural development of the body and the brain. According to brain research, for example, there can be a five-year difference in maturation between any two "average" children. Gauging achievement on the basis of chronological age is therefore inappropriate.

Photograph by Rosemary Rappoport, Hialeah, Florida

By providing a stimulating classroom environment, teachers can help satisfy the brain's enormous hunger for discovery and challenge.



Principle Three: The Search for Meaning Is Innate

The search for meaning (making sense of our experiences) is survival-oriented and basic to the human brain. The brain needs and automatically registers the familiar while simultaneously searching for and responding to novel stimuli (O'Keefe and Nadel 1978). This dual process is taking place every waking moment (and, some contend, while sleeping). Other brain research confirms the idea that people are "meaning makers" (see, e.g., Springer and Deutsch 1985, p. 33). The search for meaning cannot be stopped, only channeled and focused.

Implications for education: Brain-based education must furnish a learning environment that provides stability and familiarity. At the same time, it should be able to satisfy the brain's enormous curiosity and hunger for novelty, discovery, and challenge. Programs for gifted children already combine a rich environment with complex and meaningful challenges. Most of the creative methods used for teaching gifted students should be applied to all students.

Principle Four: The Search for Meaning Occurs Through "Patterning"

In a way, the brain is both scientist and artist, attempting to discern and understand patterns as they occur and giving expression to unique and creative patterns of its own (Lakoff 1987, Rosenfield 1988, Nummela and Rosengren 1986, Hart 1983). Designed to perceive and generate patterns, the brain resists having meaningless patterns imposed on it. By meaningless we mean isolated pieces of information that are unrelated to what makes sense to a particular student. When the brain's natural capacity to integrate information is acknowledged and invoked in teaching, vast amounts of initially unrelated or seemingly random information and activities can be presented and assimilated.

Implications for education: Learners are patterning all the time in one way or another. We cannot stop them, we can only influence the direction. Daydreaming is a form of patterning, so are problem solving and critical thinking. Although we choose much of what students are to learn, we should, rather than attempt to impose patterns, present the information in a way that allows brains to extract patterns. "Time on task" does not ensure appropriate patterning because the student may actually be engaged in "busywork" while the mind is somewhere else. For teaching to be really effective, a learner must be able to create meaningful and personally relevant patterns. This type of teaching is most clearly recognized by those advocating a whole language approach to reading (Goodman 1986; Altweger, Edelsky, and Flores 1987), thematic teaching, integration of the curriculum (Shalley 1988), and life relevant approaches to learning.

Principle Five: Emotions Are Critical to Patterning

What we learn is influenced and organized by emotions and mind-sets involving expectancy, personal biases and prejudices, self-esteem, and the need for social interaction. Thus, emotions and cognition cannot be separated (Ornstein and Sobel 1987, Lakoff 1987, McGuinness and Pribram 1980, Halgren et al. 1983). Emotions are also crucial to memory because they facilitate the storage and recall of information (Rosenfield 1988). The emotional impact of any lesson or life experience may continue to reverberate long after the specific event that triggered it.

Implications for education: Teachers must understand that students' feelings and attitudes will be involved in learning and will determine future learning. They should make sure that the emotional climate is supportive and marked by mutual respect and acceptance. Cooperative approaches to learning support this notion. Student and teacher reflection and metacognitive approaches should be encouraged. The emotional color of teacher-student encounters depends on the sincerity of the support that teachers, administrators, and students offer each other.

Principle Six: Every Brain Simultaneously Perceives and Creates Parts and Wholes

Although there *is* evidence of brain laterality, meaning that there are differences between the left and the right hemispheres of the brain (Springer and Deutsch 1985), left brain-right brain is not the whole story. In a healthy person the two hemispheres are inextricably interactive, irrespective of whether a person is dealing with words, mathematics, music, or art (Hand 1984, Hart 1975). The value of the "two-brain" doctrine is that it requires educators to acknowledge the brain's separate but simultaneous tendencies for organizing information. One is to reduce such information into parts; the other is to perceive and work with it as a whole or series of wholes.

Implications for education: People have enormous difficulty learning when either parts or wholes are neglected. Good teaching builds understanding and skills over time because it recognizes that learning is cumulative and developmental. However, parts and wholes are conceptually interactive. They derive meaning from each other. Thus, vocabulary and grammar are best understood and mastered when they are incorporated in genuine, whole-language experiences. Similarly, equations and scientific principles are best dealt with in the context of living science.

Principle Seven: Learning Involves Both Focused Attention and Peripheral Perception

The brain absorbs the information of which it is directly aware and to which it is paying attention. It also directly absorbs information and signals that lie beyond the immediate focus of attention. These may be stimuli that one perceives "out of the side of the eyes" such as gray and unattractive walls in a classroom. Peripheral stimuli also include the very light or subtle signals that are within the field of attention but are still not consciously noticed (such as a hint of a smile or slight changes in body posture). This means that the brain responds to the entire sensory context in which teaching or communication occurs (O'Keefe and Nadel 1978). One of Lozanov's (1978a, 1978b) fundamental principles is that every stimulus is coded, associated, and symbolized by the brain. Every sound (from a word to a siren) and every visual signal (from a blank screen to a raised finger) is packed full of complex meanings. Peripheral information can

Endangered Minds: Why Our Children Don't Think

Jane M. Healy
New York
Simon and Schuster, 1990

To set up her thesis, Jane Healy invites the reader into the faculty room, where teachers are grading papers and commenting on the unsettling patterns they see in their students' work—and thinking. Then she takes the reader along on a fascinating exploration of today's much-deplored decline in school achievement.

And Healy's persuasive! She clearly conveys the relationship between language learning and brain development, then explains why television viewing (*especially* "Sesame Street") and present-day lifestyles sabotage language acquisition, thinking, and personal success. She observes how ethnic heritage and social class influence language learning and applies her central thesis to the phenomena of "learning disabilities" and "attention deficit disorder." She ventures a few reassuring possibilities about the kinds of schools we need, but I'm not all that reassured—it's a tall order to do what we need to do.

Well referenced and up to date, *Endangered Minds* will help readers expand their own explanations of why achievement declined and what parents and teachers can do now.

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—Reviewed by Anne Meek

therefore be purposely organized to facilitate learning.

Implications for education: The teacher can and should organize materials that will be outside the focus of the learner's attention. In addition to traditional concerns with noise, temperature, and so on, peripherals include visuals such as charts, illustrations, set designs, and art, including great works of art. Barzakov (1988) recommends that teachers change art frequently to reflect changes in learning focus. Music has also become very important as a means to enhance and influence more natural acquisition of information. The subtle signals that emanate from a teacher also have an impact on learning. Our inner states show in skin color, muscular tension and posture, rate of breathing, eye movements, and so on. Teachers should engage the interests and enthusiasm of students through their own enthusiasm, coaching, and modeling, so that the unconscious signals relating to the importance and value of what is being learned are appropriate. Lozanov (1978a, 1978b) coined the term "double planeness" to describe the congruence of the internal and external in a person—it is important to practice what we preach and to express genuine feelings rather than to fake them, because our true inner states are always signaled and discerned at some level by learners.

Principle Eight: Learning Always Involves Conscious and Unconscious Processes

We learn much more than we ever consciously understand. Most of the signals that we peripherally perceive enter the brain without our awareness and interact at unconscious levels. "Having reached the brain, this information emerges in the consciousness with some delay, or it influences motives and decisions" (Lozanov 1978b). Thus, we remember what we experience, not just what we are told. A student can easily learn to sing on key and learn to hate singing at the same time. Teaching should therefore be designed in such a way as to help students benefit maximally from unconscious processing. In part this is done by addressing the peripheral context (as described above). In part it is done through instruction.

Implications for education: A great deal of the effort put into teaching and studying is wasted because students do not adequately process their experiences. "Active processing" allows students to review how and what they learned so that they can begin to take charge of their learning and the development of their own personal meanings. It refers to reflection and metacognitive activities—for example, a student might become aware of his or her preferred learning style. Teachers may facilitate active processing by creatively "elaborating" procedures and theories through metaphors and analogies to help students reorganize the material in personally meaningful and valuable ways.

Principle Nine: We Have Two Types of Memory: A Spatial Memory System and a Set of Systems for Rote Learning

We have a natural spatial memory system which does not need rehearsal and allows for "instant" memory of experiences (Nadel and Wilmer 1980, Nadel et al. 1984, Bransford and Johnson 1972). Remembering what we had for dinner last night does not require the use of memorization techniques. That is because we have at least one memory system actually designed for registering our experiences in ordinary three-dimensional space (O'Keefe and Nadel 1978). The system is always engaged and is inexhaustible. It is enriched over time as we increase our repertoire of natural categories and procedures (there was a time when we did not know what a tree or a television was). The system is motivated by novelty. In fact, this is one of the systems that drives the search for meaning.

Facts and skills that are dealt with in isolation are organized differently by the brain and need much more practice and rehearsal. The counterpart of the spatial memory system is a set of systems specifically designed for storing relatively unrelated information (O'Keefe and Nadel 1978). The more information and skills are separated from prior knowledge and actual experience, the more we depend on rote memory and repetition. These systems operate according to the information processing model of memory which suggests that all new information must be worked on before it is stored. However, concentrating too heavily on the storage and recall of unconnected facts is a very inefficient use of the brain.

Implications for education: Educators are adept at focusing on memorization of facts. Common examples include multiplication tables, spelling, and sets of principles in different subjects. However, an overemphasis on such procedures leaves the learner impoverished, does not facilitate the transfer of learning, and probably interferes with the development of understanding. By ignoring the personal world of the learner, educators actually inhibit the effective functioning of the brain.

Principle Ten: The Brain Understands and Remembers Best When Facts and Skills Are Embedded in Natural Spatial Memory

Our native language is learned through multiple interactive experiences involving vocabulary and grammar. It is shaped both by internal processes and by social interaction (Vygotsky 1978). That is an example of how specific items are given meaning when embedded in ordinary experiences. Education is enhanced when this type of embedding is adopted. Embedding is the single most important element that the new brain-based theories of learning have in common.

Implications for education. The embedding process is complex because it depends on all the other principles discussed above. Spatial memory is generally best invoked through experiential learning, an approach that is valued more highly in some cultures than in others. Teachers should use a great deal of "real life" activity including classroom demonstrations, projects, field trips, visual imagery of certain experiences and best performances, stories, metaphor, drama, interaction of different subjects, and so on. Vocabulary can be "experienced" through skits. Grammar can be learned "in process" through stories or writing. Mathematics, science, and history can be integrated so that much more information is understood and absorbed than is presently the norm. Success depends on making use of all the senses by immersing the learner in a multitude of complex and interactive experiences. Teachers should not exclude lectures and analysis, but they should make them part of a larger experience.

Principle Eleven: Learning Is Enhanced by Challenge and Inhibited by Threat

The brain learns optimally when appropriately challenged, but "downshifts" under perceived threat (Hart 1983). In the language of phenomenology, we narrow the perceptual field when threatened (Combs and Snygg 1959) by becoming less flexible and by reverting to automatic and often more primitive routine behaviors. The hippocampus, a part of the limbic system, appears to function partially as a relay center to the rest of the brain. It is the part of the brain most sensitive to stress (Jacobs and Nadel 1985). Under perceived threat, we literally lose access to portions of our brain, probably because of the extreme sensitivity of the hippocampus.

Implications for education. Teachers and administrators should strive to create a state of relaxed alertness in students. This means that they need to provide an atmosphere that is low in threat and high in challenge. This state must continuously pervade the lessons and must be present in the teacher. All the methodologies the teacher uses to orchestrate the learning context influence the state of relaxed alertness.

Principle Twelve: Each Brain Is Unique

Although we all have the same set of systems, including our senses and basic emotions, they are integrated differently in each and every brain. In addition, because learning actually changes the structure of the brain, the more we learn, the more unique we become.

Implications for education. Teaching should be multifaceted in order to allow all students to express visual, tactile, emotional, or auditory preferences. Choices should also be variable enough to attract individual interests. This may require the reshaping of learning organizations so that they exhibit the complexity found in life. In sum, education needs to facilitate optimal brain functioning.

What Schools Should Do

The objective of brain-based learning is to move from memorizing information to meaningful learning. This requires that three interactive elements be present: relaxed alertness, immersion, and active processing (Caine and Caine 1989).

Relaxed alertness as a state of mind meets the brain's preference for challenge and its search for meaning. Teachers should provide an atmosphere that combines a sense of low threat with significant challenge and the degree of relaxation characteristic of people who are confident and at ease with themselves. This is a delicate balance.

Teachers should orchestrate the immersion of their students in appropriate experiences because all learning is experiential in some sense and because it is the sense that students make of their experience as a whole that determines the degree of learning. Class and school curriculums should overlap. Educators can integrate subjects such as science, mathematics, history, and reading. They can make their schools into small, healthy, "real-world" communities where students, young and old alike, are given responsibilities for handling ceremonies, news flyers, clean-up, and supervisory functions (such as zookeeper, head gardener, and public relations person).

Active processing, through such activities as questioning and genuine reflection, allows learners to take charge of the consolidation and internalization of learning in a way that is personally meaningful. Students may keep a personal journal, for example, leaving the way open for their brains to see things in a new light. Active processing also allows students to recognize and deal with their own biases and attitudes and to develop thinking skills and logic as they search for broader implications and connections for what they are learning. These techniques for metacognition and reflection are very sophisticated and take a more concrete form in the lower grades.

Understanding how the brain learns has implications for instructional design, administration, evaluation, the role of the school in the community, teacher education, and a host of other issues critical to educational reform. The evidence suggests not only that we learn from experiences but that there is much more to this process than we have appreciated. Acknowledging how the brain learns from experiences will help us to understand meaningful learning more fully. In that sense, brain-based learning is not a separate thrust or movement in education; it is an approach from which all education will ultimately benefit.☐

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