## 3. Twelve Principles of Brain based Learning

Brain-based learning network has been called a combination of brain science and common sense. The human brain's interconnections exceed the Internet's by an astronomical number. Educators are increasingly relying on brain-based learning theory.

Imaging technologies such as MRIs are helping scientists understand memory, recall, and how the brain manages information and information overload (Weiss, 2000).

Researchers have called the brain "the organ of learning." Researchers have developed twelve principles that apply what we know about the function of the brain to teaching and learning (www.psycheducation.org). These principles were derived from an exploration of many disciplines and are viewed as a framework for thinking about teaching methodology (Jensen, 1995). The core principles of brain based learning are (**Markovchick, 2007):**

Principle One: The brain is a parallel processor. The brain is a complex adaptive system. Perhaps the most potent feature of the brain is its capacity to function on many levels and in many ways simultaneously. Thoughts, emotions, imagination, predispositions and physiology operate concurrently and interactively as the entire system interact with and exchanges information with its environment. Good teaching takes this into

consideration. That's why we talk about the teacher as an orchestrator or facilitator of learning.

Principle Two: Learning engages the whole physiology. The brain is a social brain. We begin to be shaped as our immensely receptive brain/minds interact with our early environment and interpersonal relationships. It is now clear that throughout our lives, our brain/minds change in response to their engagement with others - so much so that individuals must always be seen to be integral parts of larger social systems. Indeed, part of our identity depends on establishing community and finding ways to belong. Learning, therefore, is profoundly influenced by the nature of the social relationships within which people find themselves.

The physical health of the child -- the amount of sleep, the nutrition -- affects the brain. So do moods. We are physiologically programmed, and we have cycles that have to be honored. An adolescent who does not get enough sleep one night will not absorb much new information the next day. Fatigue will affect the brain's memory (www.talkingpage.org).

Principle Three: The search for meaning is innate. In general terms the search for meaning refers to making sense of our experiences. At its core the search for meaning is purpose and value driven. Something of the extent of human purposes was expressed by Maslow. Included are such basic questions as "who

am I?" and "why am I here?" Thus, the search for meaning ranges from the need to eat and find safety, through the development of relationships and a sense of identity, to an exploration of our potential and the quest for transcendence.

This means that we are naturally programmed to search for meaning. This principle is survival oriented. The brain needs and automatically registers the familiar while simultaneously searching for and responding to additional stimuli. What does this mean for education? It means that the learning environment needs to provide stability and familiarity. Provision must be made to satisfy the hunger for novelty, discovery, and challenge. At the same time lessons need to be exciting and meaningful and offer students an abundance of choices (www.talkingpage.org).

Principle Four: The search for meaning comes through patterning. Patterning refers to the organization and categorization of information. The brain resists having meaningless patterns imposed upon it. By "meaningless" we mean isolated and unrelated pieces of information. When the brain's natural capacity to integrate information is evoked in teaching, vast amounts of seemingly unrelated or random information and activities can be presented and assimilated. The brain tries to make sense of the information by reducing it to familiar patterns (www.talkingpage.org).

The brain/mind needs and automatically registers the familiar while simultaneously searching for and responding to novel stimuli. In a way, therefore, the brain/mind 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. Really effective education must give learners an opportunity to formulate their own patterns of understanding.

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. Hence an appropriate emotional climate is indispensable to sound education.

In the brain you can't separate out emotion from cognition. It is an interacting web of factors. Everything has some emotion to it. In fact, many brain researchers now believe there is no memory without emotion. Emotions are what motivate us to learn, to create. They are in our moods. They are our passion. They are a part of who we are as human beings. We need to understand more about them and accept them (www.talkingpage.org).

Emotion impels what we attend to, and attention drives learning. So, one of the important things we have to do is to ensure that learners become emotionally involved in whatever we're teaching them. If they don't get emotionally hooked on

some level, they don't pay attention; if they don't pay attention, they don't learn. In fact, the more emotionally engaged a learner is the more likely he or she is to learn. The big question for learners and teachers is how do they do that? (Weiss, 2000)

Principle Six: The brain processes wholes and parts simultaneously. Although there is some truth to the "left-brain right-brain" distinction, that is not the whole story. In a healthy person, both hemispheres interact in every activity, from art and computing to sales and accounting. The "two brain" doctrine is most useful for reminding us that the brain reduces information into parts and perceives holistically at the same time. Good training and education recognize this, for instance, by introducing natural "global" projects and ideas from the very beginning.

Principle Seven: Learning involves both focused attention and peripheral perception. The peripherals play an important role. Children learn from everything. Everything goes into the brain. In the early years they literally become their experiences. Therefore the environment is very important, and if they learn something in the classroom and never use it outside the classroom, then that learning, those connections, stop there. In other societies, children are immersed in learning in the school, in the home, in the community. Their knowledge is

used and is expanded upon. They interact with each other in this rich learning environment (www.talkingpage.org).

Educators, therefore, can and should pay extensive attention to all facets of the educational environment which includes instructional technologies.

Principle Eight: Learning involves both conscious and unconscious processes. One aspect of consciousness is awareness. Much of our learning is unconscious in that experience and sensory input is processed below the level of awareness. That means that much understanding may NOT occur during a class, but may occur hours, weeks or months later. It also means that educators must organize what they do so as to facilitate that subsequent unconscious processing of experience by students. In practice this includes proper design of the context, the incorporation of reflection and metacognitive activities and ways to help learners creatively elaborate on the ideas, skills and experiences. Teaching largely becomes a matter of helping learners make visible what is invisible.

What we call "active processing" allows students to review how and what they've absorbed so they begin to take charge of their learning and of the development of personal meaning. Meaning is not always available on the surface. Meaning often happens intuitively in ways that we don't understand. So that, when we learn, we use both conscious and unconscious processes.

In teaching, you may not reach a student immediately, but two years later he may be in another class and say, "I get it now." You are a part of that, but you are no longer present (www.talkingpage.org).

Principle Nine: We have two types of memory: spatial and rote. We have at least two ways of organizing memory. Although there are many models of memory, one that provides an excellent platform for educators is the distinction made by O'Keefe and Nadel between taxon and locale memories. They suggest that we have a set of systems for recalling relatively unrelated information (taxon systems, from "taxonomies"). These systems are motivated by reward and punishment. O'Keefe and Nadel also suggest that we have a spatial/autobiographical memory which does not need rehearsal and allows for "instant" recall of experiences.

In the taxon memory system, things are learned by rote. We memorize information, but that doesn't mean we can use the information. The taxon system has nothing to do with imagination or creativity. It conforms very readily to the information processing model of memory. With this system, students are motivated by reward and punishment; many trials are usually needed; and the brain is easily fatigued since there is stress on a limited number of brain cells. This is the model schools are based on. We have limited education to "programming" these

taxon systems and "teaching to the test." Can you see why people would say that our educational system is based on teaching to the test (and forgetting it afterwards) is not very successful? (www.talkingpage.org).

Learning means that information is related and connected to the learner. If it's not, you have memorization, but you don't have learning. There are still things we have to memorize, things that need to be repeated. Multiplication tables are very useful, but we want to make sure that children understand the concept of multiplication (www.talkingpage.org).

The locale memory system puts it all together as a picture. You're not just seeing one piece at a time and adding it together like a mathematical formula and coming up with a whole. That's a big message of brain research: parts are contained in a whole, and the whole has parts. It sounds very simple, but it's not when you start developing lessons (www.talkingpage.org).

Principle Ten: We understand best when facts are embedded in natural, spatial memory. Learning is developmental. Development occurs in several ways. In part, the brain is "plastic". That means that much of its hard wiring is shaped by the experiences that people have. In part, there are predetermined sequences of development in childhood, including windows of opportunity for laying down the basic hardware necessary for later learning. That is why new languages as well

as the arts ought to be introduced to children very early in life. And finally, in many respects there is no limit to growth and to the capacities of humans to learn more. Neurons continue to be capable of making new connections throughout life.

The solution is to embed taxon learning by immersing learners in well-orchestrated, life-like, low-threat, high-challenge learning environments. We need to take the information off the blackboard, to make it come alive in the minds of learners, and to help them to make connections (www.talkingpage.org).

Principle Eleven: Learning is enhanced by challenge and inhibited by threat. The brain/mind learns optimally - it makes maximum connections - when appropriately challenged in an environment which encourages taking risks. However, the brain/mind "downshifts" under perceived threat. It then becomes less flexible, and reverts to primitive attitudes and procedures. That is why we must create and maintain an atmosphere of relaxed alertness, involving low threat and high challenge.

The hippocampus, which is located just above your nose and above your ears in the center where they intersect, is part of the limbic system. It has proportionally more receptors for stress hormones than any other portion of the brain. It is also critical in forming new memories and is linked to the indexing

function of the brain. It allows us to make connections, to link new knowledge with what is already in the brain. It is like a camera lens, and, under threat related to helplessness, it closes off. We then move back into well-entrenched behaviors. It opens up when we are challenged and are in a state of "relaxed alertness." When the learner is empowered and challenged, you begin to get the maximum possibility for connections. That is why the brain needs stability as well as challenge. If short term stability is lost, then long-term stability must be substituted (www.talkingpage.org).

"It really has to do with power and control," says Caine. "People [who have a tyrannical instructor] tend to learn only what they think will please the instructor. They'll do what they can get away with but are unlikely to [be creative]. It isn't just psychological; it's physiological (Weiss, 2000).

Rest is the basis of activity. Notice how fresh you feel after a vacation. We need to teach our children that learning takes time. And children need to understand their natural rhythms. We need an orderly environment. We need to understand ourselves and our own needs better. We need to acknowledge our need for ritual, for orderliness (www.talkingpage.org).

**Principle Twelve: Every brain is uniquely organized.** We all have the same set of systems, and yet are all different. Some of this difference is a consequence of our genetic endowment. Some

of it is a consequence of differing experiences and differing environments. The differences express themselves in terms of learning styles, differing talents and intelligences and so on. An important corollary is both to appreciate that learners are different and need choice, while ensuring that they are exposed to a multiplicity of inputs. Multiple intelligences and vast ranges in diversity are, therefore, characteristic of what it means to be human.

The "brain-based learner" downshifts under threat, learns via peripheral events, has a unique brain, learns via conscious and unconscious processes, has various types of memory, and learns best when content is embedded in experience. At the end the implications of brain-based learning for education are (Horn, 2007):

1. Curriculum: Designing learning around student interest and making learning contextual.
2. Instruction: Having students learn in teams. Making use of peripheral learning. Structuring learning around real problems and allowing learning settings outside the classroom and school building.
3. Assessment: All students are learning. Students' assessment should include an understanding of their own

learning styles and preferences. Students monitor and seek to maximize their own learning process.