1 Learning, Growth, and the Brain

In recent years, what we have learned about how the brain is organized and functions raises questions for us as teachers. According to Ornstein (1986), the brain is a complex biological organ made of several systems embedded within its structures:

> Stuck side by side, inside the skin, inside the skull, are several special purpose, separate, and specific small minds. The particular collection of talents, abilities, and capacities that each person possesses depends partly on birth and partly on experience. Our illusion is that each of us is somehow unified with a single coherent purpose and action . . . [but] we are not a single person. We are many. . . . All of these general components of the mind can act independently of each other, [and] they may well have different priorities. (pp. 8–9)

These functions are not processed consciously but occur automatically. The truth is that the brain naturally learns what it needs to if there is useful information, if the information is interesting, and if the challenge is appropriate.

THE NATURAL PROCESS OF LEARNING

Restak (1994) identifies five systems that are constantly interacting, with multiple connections, as we accept, process, and interpret information. This is like a 24/7 "multiplex theater" according to Barbara Given (2002), where multiple movies are showing simultaneously. The five systems are the emotional learning system, the social learning system, the physical learning system, the cognitive learning system, and the reflective learning system.

Emotional Learning System

Emotions and social interactions that affect feelings can inhibit academic progress (Rozman, 1998). For example, students will seek first to be safe and comfortable before they care what there is to be learned. Emotional nourishment is essential from birth to death (Kessler, 2000; Palmer, 1993), and emotions have a huge effect on the ability to focus and learn. Endorphins and norepinephrine (the feel-good neurotransmitters released in the brain during positive experiences) contribute to learning as well as to good health (Pert, 1993). Emotions are both innate and acquired, learned from peers and parents throughout life but especially in the early years (Harris, 1998).

When our emotional needs are met, the brain produces serotonin (a feel-good neurotransmitter). Sometimes young people turn to drugs to eradicate the negative feelings in their lives, but feeling good without drugs can occur when students feel included and part of the group—that "warm, feel-good" reaction when they know someone cares. Csikszentmihalyi (1990) refers to the "state of flow" where attention is focused and one's skill level is matched with an appropriate challenge. In this state, a person feels "in the groove" and capable and empowered to be successful.

The emotional system is embellished in classrooms and schools with the following attributes:

- Where educators and students believe all students will learn
- Where students' differences are honored
- Where teachers connect the learning to students' lives
- Where teachers provide multiple ways for students to show what they know
- Where teachers continue to challenge students appropriately at their level
- Where the climate is supportive, inclusive, and predictable
- Where students and teachers celebrate the gains toward targeted standards
- Where students and teachers can laugh and celebrate together
- Where intrinsic motivation and pride in a "job well done" is fostered
- Where students' intrinsic motivation is cultivated through goal setting and reflection

Social Learning System

Part of the developmental process through the first few years of life is to form relationships with others. A system in place at birth relates to paired relationships. Another system progresses toward group relationships (Harris, 1998). It is a basic human need to feel that we belong and are accepted and included. Feelings of comfort, trust, respect, and affection

increase the brain's feel-good neurotransmitter levels (Panksepp, 1998). Often in classrooms there is such a quest to "cover the standards" that there is no opportunity to develop social interactions that promote trust and connections even though we know students will learn better in a supportive environment. A kinship fostered by group norms and values is more conducive to learning (Wright, 1994). Robert Sapolsky in his book *Why Zebras Don't Get Ulcers* suggests that social support has a huge impact on student learning. Students who feel part of the group and accepted by their peers are more confident and experience less stress in difficult learning situations. It is essential that teachers create a community of learners where every student feels a sense of belonging. A teacher who is aware of this need can capitalize on this knowledge by creating a classroom climate that provides the following:

- Respect for all learners
- Recognition for students' hopes and aspirations
- A multisensory environment for real-world learning (Given, 2002)

The use of cooperative group learning is essential in a classroom, not only to allow the social system to flourish but also to help students achieve academic goals as well as social skills.

Physical Learning System

The physical learning system has to do with active involvement in learning. In classrooms, this is often the system that is not used enough even though we know that gifted students (Milgram, Dunn, & Price, 1993) and underachievers (R. Dunn, 1990) will benefit from active, tactile, and kinesthetic involvement with new material.

If we ignore this system, the learners will find a way to "actively" satisfy their needs in spite of our plans. The movement might seem a disruption and have nothing to do with the lesson at hand. So how do we build in opportunities for hands-on, active learning, or do we let students find their own ways, which may be counterproductive to learning? The physical system also demands movement to lower stress (adrenalin and cortisol, stress hormones in the blood stream) and supply more oxygen and glucose to the brain. Paul and Gail Dennison's book *Brain Gym* offers suggestions and activities to "wake up the brain" and integrate the right and left hemispheres.

Cognitive Learning System

The cognitive system deals with learning and focuses on consciousness, language development, attention, and memory. The senses are engaged

in actively processing information. Facilitating learning by providing information in a novel way—one that stimulates all senses, including the visual, auditory, and tactile senses as well as taste and smell if appropriate—is something good teachers do.

The emotional, social, and physical systems seem greedy for attention, and if their needs are not met, students will not be able to focus on learning; thus the cognitive system cannot work optimally. If all systems' needs are met, students tend to be more attentive and engaged in the learning process and ultimately are more successful in their learning.

Reflective Learning System

It has been said that people learn from experience only if they reflect on the experience. This intelligence includes "thinking strategies, positive attitudes toward investing oneself in good thinking, and metacognition—awareness and management of one's own mind" (Perkins, 1995, p. 234). Damasio (1999) notes that the reflective system involves the interdependence of memory systems, communication systems, reason, attention, emotion, social awareness, physical experiences, and sensory modalities.

The reflective system allows us to do the following:

- Revisit and analyze situations
- Explore and react with ideas
- Create plans
- Facilitate progress toward goals

With limited time and multiple standards to achieve, this may be the system that is ignored in the classroom. These skills of continuous reflection and self-awareness are key to growth. The skills of metacognition and reflection enable students to form a complete image of self and to develop the strategies necessary to self-directed learning and success in life.

Figure 1.1 lists needs and preferences within each system and suggests classroom activities/strategies that teachers can use to satisfy those needs and preferences.

SAFETY AND THE SURVIVAL BRAIN

The brain was put in the head not to go to school but to survive on the savannah. Its first tasks toward survival are to get upright and mobile, communicate, and develop trust through interpersonal relationships.

Figure 1.1 The Five Natural Learning Systems in the Classroom

System	Needs and Preferences	Classroom Strategies
Emotional system  Passion	• Positive climate • Emotional safety • Relevancy and meaning • Supportive learning community • Tapping into range of emotions Teacher as cheerleader, mentor	Build the classroom community and a positive climate by • Building trust • Providing appropriate challenge and feedback • Adjusting assignments
Social system  Cooperation	• Inclusion • Respect • Enjoy others • Interaction • Interpersonal sharing • Authentic situations • Tolerance and diversity honored Teacher as consultant, coach	• Developing norms • Using teambuilding activities • Outlawing "put downs" • Using cooperative group learning • Simulations
Cognitive system  Intention	• Promotes academic skill development • Connects prior learning and new learning • Seeks patterns, concepts, themes • Likes to see parts and the whole Teacher as facilitator	• Thinking skills • Graphic organizers • Advance organizers • Note taking and summarizing • Hypothesizing • Problem solving
Physical system  Action	• Requires active involvement • Enjoys challenging tasks that encourage practice • Skills are a major part of this system Teacher as coach	• Mime • Pantomime • Role play • Building models • Hands on • Manipulatives • Simulations
Reflective system  Introspective	• Personal reflection on one's own learning styles • Reflects on successes, failures, changes needed • Metacognition of one's strengths and preferences Teacher as gold miner	• Logs • Journals • Tickets out • Goal setting • PMI

Unfortunately, when we look around schools, many classrooms are diametrically opposite to these basic human quests. Classrooms where students are to stay in desks, not talk to others, and compete against their peers do not support the brain's natural functions and tendencies. This produces undue stress, and when there is stress, no thinking takes place. A person concerned with basic needs is not able to attend to the learning that should be taking place. The brain is no longer functioning in the neocortex but in the reptilian brain where there is no language or thought processing but instead a basic "fight or flight" reaction.

If students are controlled to the point where there is no option or choice to pursue learning in their own style or to show what they know in their own way, they will be stressed. If they have to find the one right answer by doing only one prescribed task, this may add unnecessary stress (and boredom) for the learner.

Choice and options give learners a sense of control over their own learning. The optimal climate we should be striving for is *high challenge, low threat,* where skill and task are balanced so that students can see success while stretching their skills and thinking. Csikszentmihalyi (1990) refers to this condition as flow, where the following conditions exist:

- Challenge and skill level are well matched.
- Choice and options are available.
- Feedback is ongoing.
- There is an intrinsic sense of satisfaction.
- Time goes by unnoticed.
- The learner is in the groove.
- Students are inspired by the task or activity to persevere.

This is a mammoth challenge when there is one teacher and a classroom full of diverse learners, but paying attention to learning styles and using strategies to give students choice and options give flow a greater chance of happening.

Not only is physical safety necessary in the classroom but so are emotional and psychological safety. Students need to know they are safe to share ideas and offer opinions without fear of ridicule, sarcasm, teasing, and antagonism from teachers or other students. This kind of positive climate is facilitated through the following:

- Norms that students generate and support (rules to live by)
- An orderly and consistent environment that is nurturing and patient
- Choice and options rather than control
- Respect for diversity: cultural, thinking, learning style
- Positive reinforcement and encouragement
- Invitational approaches that engage rather than exclude
- A sense of community and belonging in the group

BRAIN-COMPATIBLE LESSON PLANNING

Madeline Hunter (2004) was not far off what we now call brain-compatible learning. Her lesson-planning model looks at seven steps that teachers should consider in planning a lesson.

1. Activating prior knowledge: Opening mental files and setting the context of learning. Capturing attention. Providing an overview. Any information stored in long-term memory needs to be recalled and brought to short-term memory.

2. Stating the objectives and purpose: Tying the learning to the standards and/or outcomes to provide relevancy. The brain likes to know purpose and responds to meaningful and useful information.

3. Instructional phase/input: Providing information and content to develop concepts and skills. The Hunter model suggests that this is a didactic process; however, it can be done in a variety of ways: lecturette, video, jigsaw, guest speaker, text, or through the use of other technologies.

4. Modeling: Showing the learner what the skill looks like and sounds like. Providing a pattern for the brain to follow.

5. Checking for understanding: Students can show what they know or understand in a variety of ways, including writing, retelling, and demonstrating.

6. Practice and application: With the information, and after modeling by the teacher, students can apply their knowledge and skills in a practical way in situations that are meaningful and relevant to their own lives. Problem solving, projects, centers, and stations give ample opportunities for hands-on application and creativity. The brain loves novelty and relevance, and meaning is key to learning. These forms of application tap into all theaters of the mind.

7. Closure and extension: Bringing the lesson to closure is important to the brain because it doesn't like loose ends and wants to see the big picture. Opportunities for extension of the learning and challenging those learners who are at a higher level of readiness or ability may be offered.

SEVEN COMMON BRAIN PRINCIPLES

The following concepts have been gleaned from notable educators and researchers who have followed in Madeline Hunter's footsteps. These include Pat Wolfe (2001), David Sousa (2001), Barbara Given (2002), Robert Sylwester (2005), Renate and Geoffrey Caine (1991, 1997), and others.

1. Pattern Recognition and Schemas

The brain operates on probability based on past experiences. Schemas are patterns, clusters, arrangements, and categories stored together and understood. This is how we develop concepts by identifying like attributes of ideas. Chaining is the process of making connections by finding commonalities. Dr. Mel Levine (1990) calls this "horizontal threading." The brain checks its filing system to find other ideas and concepts that may be connected to the new learning. The brain will reject useless patterns and pieces of information that are not connected to what it already knows or finds intriguing.

Implications for Learning

Past experiences are unique and specific to each learner. Meaning comes from making connections, and without schemas, students' connections are not complete. Schemas can be helpful in finding relationships when learning something new.

Teachers can influence pattern in these ways:

- Presenting schemas as advance organizers
- Embedding skills in real-world contexts
- Integrating skills across the curriculum
- Ensuring that new learning has real-world application

2. Emotions Are Critical to the Learning Process

Emotions are inextricable from the learning process (Ornstein & Sobel, 1987). Most learning depends on our state of mind, emotions, goals, and personal sense of confidence. Emotions facilitate the storage of memories and help in the recall process.

Implications for Learning

The emotional climate set for the classroom is crucial to student success. It is essential that teachers and students are supportive and cooperative. As previously mentioned, a positive climate is necessary for optimal learning.

3. Learning Involves the Entire Physiology

Learning is a natural process (Smilkstein, 2003). The brain constantly looks for new information, is curious, and is self-perpetuating if given the opportunity. Relevance, personal meaning, or novelty, if present, helps the process along. Our experiences help promote neuron growth and brain development (Diamond, 1988). The brain is very susceptible to either

positive or negative experiences. To grow dendrites, students need enriched environments that include stimulation of all senses—visual, auditory, and kinesthetic modes of learning. This premise also supports the five natural learning systems (Given, 2002) and tends to be true for all learners regardless of their learning styles or multiple intelligence strengths.

Implications for Learning

Although there are some common themes in terms of the brain's functioning, each brain is unique based on life experiences and emotional situations. Not all students are at the same level of maturation at the same chronological age. There may be up to five years' difference in maturation between any two "average students." Attributing delays based on chronological age may not be accurate but may cause undo anxiety and stress in students and parents if expectations are based on chronological growth.

4. Searching for Meaning

The search for meaning is a basic survival instinct. The brain recognizes the familiar and also looks for novelty (O'Keefe & Nadel, 1978). This occurs while we are awake or asleep. It is impossible to shut this search down. The best we can do is channeling this quest and helping the learner focus by using contracts, projects, questions, and inquiry.

Implications for Learning

This challenges teachers' ability to structure an environment that is familiar yet has novelty, challenge, and investigative capacity. Programs must build on the familiar while also creating a sense of wonderment and challenge. Engagement in reading, writing, and speaking with interesting and relevant topics is crucial to intrigue the learner.

5. Learning Is Social

The need to connect, associate, collaborate, and cooperate is prevalent in all humans as well as other species (Panksepp, 1998). However, some of us have more of a need for social interaction. We tend to place value on independence and interdependence as a positive human trait (Covey, 1989). Basically, students need to feel that they belong, are contributing members of a group, and are accepted and respected.

Implications for Learning

Because social interactions are such an innate part of human nature, it would be counterproductive to outlaw oral communication in the classroom. This can be especially frustrating for those interpersonal or "puppy"

learners who need to dialogue and share ideas and "talk out their thinking" with someone else.

6. Learning Involves Conscious and Unconscious Attention

The brain is continually concerned with making sense of the world (Sylwester, 1995). Everything from body language, classroom climate, and physical environment, including décor and orderliness is included in peripheral stimuli. This is subconscious, but the brain still registers it and reacts to it. There is a climate that permeates the classroom and the school that is picked up by students and teachers alike.

Implications for Learning

Environment and subtleties in the classroom affect the learners. Tone of voice, cheerful displays in classrooms with the use of support structures such as charts, diagrams, word walls, and visuals help students with their learning. The teacher's concern for his or her students and personal enthusiasm for learning influences students at the unconscious level and relates both the joy and value of learning. The brain picks up subconscious messages and responds in a positive or negative way as a result of that information. What we do screams louder than what we say.

7. Every Brain Is Unique

Although every brain operates in basically the same way, we know that each one is unique. This is a result of nature and nurture (heredity and environment). We each have a genetic makeup and various experiences and environments that have influenced and constructed our brains differently over time.

Implications for Learning

These differences play out through learning styles and different strengths in areas of intelligence. Circumstances, including culture, poverty, first language, and special needs, add diversity to the learners' individual profile.

THE TWO HEMISPHERES OF THE BRAIN

Research from Roger Sperry (1968) identified two different hemispheres of the brain and two different ways of processing information. One side seems to be dominant in each of us, and research also indicates that gender plays

a role in hemisphere dominance as well (Baron-Cohen, 2003; Blum, 1997; Gurian, Henley, & Trueman, 2001; Havers, 1995; Moir & Jessel, 1989; Rich, 2000; Taylor, 2002; Witelson, 2004). Figures 1.2 and 1.3 itemize the processes linked with each hemisphere and suggest what the hemisphere dominance looks like in the classroom. Figures 1.4 and 1.5 detail the structural and performance differences linked to male and female brain hemispheres.

This is not to say that we should do only one activity or the other based on the student's gender, but we should provide a full range of activities that develop both sides of the brain (see Figure 1.6). Sometimes we can ask girls to engage in activities that require more manipulation, with opportunities to build, construct, calculate, and design. And sometimes boys can be required by design to verbally describe what they are doing; it is easier for them to vocalize when actively involved in a task. There is more blood flow to the cerebellum (the motor brain) at that time, and thus their vocabulary will be greater.

Figure 1.2 Brain Processes Linked to Left and Right Hemispheres

Left Hemisphere	Right Hemisphere
Controls the right side of the body	Controls the left side of the body
Logical use of information	Spontaneous reaction to information
Analytical with data	Intuitively responds to information (commonsense approach)
Time sensitive and aware	Does not consider time
Deals with life sequentially	Deals with life randomly
Organizes information	Diffuses information
Uses formal and systematic ways to deal with information and materials	Uses spur of the moment to deal with information and materials
Processes from whole to parts and reorganizes the whole (sees the trees)	Sees the big picture or the whole (sees the forest)
Responds to verbal communication both receiving and expressing	Responds to body language, touch, and intonational pitch
Music: writes scientifically	Music: responds to sound and tone
Practical and factual	Focuses on ideas, theories, and uses imagery
Generates spoken language	Interprets language
Control emotions, feelings	Free with feelings and emotions
Uses mathematics and computations	Uses intuition to perceive and estimates
Responds to abstract-oriented thinking	Responds to sensory-oriented thinking
Concrete, explicit, and precise	Symbolic and metaphorical

NOTE: To read more about this, see Carter (1998) and Gazzaniga (1998a, 1998b).

Figure 1.3 Preferences in the Classroom Related to Dominant Hemisphere

Left-Hemisphere Dominance	Right-Hemisphere Dominance
• Prefers facts	• Prefers possibilities
• Relies on logical analysis and systemic solutions	• Relies on intuition and hunches to solve problems
• Repetition/rehearsal	• Likes inventive options
• Traditional use of materials	• Innovative use of materials
• Order	• Random and haphazard
• Precision	• Spontaneity
• Models	• Elaborates on the original
• Demonstrations	• Expands on ideas given
• Expectations drive learning	• Curiosity drives learning
• Relies on feedback for success	• Suggests options
• Clear directions	• Jumps into task without directions
• Instructions from teacher (auditory)	• Experiments with ideas
• Seeks approval	• Shows others their accomplishments
• Likes multiple-choice test questions	• Prefers essay questions on test

Figure 1.4 Gender Differences: Structural

Male	Female
Higher percentage of gray matter in left.	Same amount of gray matter in both hemispheres.
Have more neurons in the cerebral cortex.	Females have more connections between the neurons in the same size space.
Left hemisphere has language areas for both males and females.	Females have an active processor in their right brain as well.
Boys have less blood flow in their brains.	Female corpus callosum (connecting the left and right hemispheres) is generally larger than males (almost 25% in adolescence).
Boys' brains "renew, recharge and reorient" through the process of a *rest state*	Girls reorient without a *rest state*.
More cortical area devoted to spatial processing.	In the temporal lobes, girls have more neural connectors than boys. Thus they store more sensory details, often have a greater ability to listen, and pick up intonation clues while listening.
	The hippocampus in girls is generally larger as well. Because it processes memory storage, girls have a learning advantage, especially in language arts.
	Girls' prefrontal lobes are more active at an earlier age, and this decreases the impulsivity often apparent in male behavior.
Boys have less serotonin and also less oxytocin (human bonding chemical). They are thus more physically impulsive and sometimes less demonstrative of affection.	Girls generally have higher levels of serotonin in the blood, which makes them less impulsive.

NOTE: Based on information compiled from multiple sources, including the work of Witelson (2004), Moir and Jessel (1989), Taylor (2002), Havers (1995), Gurian et al. (2001), Rich (2000), Baron-Cohen (2003), and Blum (1997).

Figure 1.5 Gender Differences: Performance

Male	Female
Males use more cortical area for spatial and mechanical functioning. Perform better on spatial tasks such as • three-dimensional rotation of objects, • motor skills, • noticing embedded shapes, • throwing accuracy, • mathematical reasoning. Males lateralize and tend to compartmentalize their learning.	Females use generally more cortical area for emotive and verbal processing. Perform better on • perceptual speed tests, • verbal fluency, memory, • sequence, • identifying specific attributes of an object, • manual precise tasks (finger dexterity), • mathematical calculations. Females are better at noticing a variety of emotions (temporal lobes) in others and use a greater amount of their limbic system to do so. Multitasking is easier for girls. They make transitions easier from one thing to another. They are more able to focus.

NOTE: Based on information compiled from multiple sources, including the work of Witelson (2004), Moir and Jessel (1989), Rich (2000), and Blum (1997).

Figure 1.6 Teaching to Gender Differences

Teaching Boys	Teaching Girls
• Offer as many kinesthetic, hands-on activities as possible: manipulatives, construction, projects, experiments.	• Encourage physical activity to develop gross motor skills.
• Provide tasks that include fine motor (not as highly developed in males) as well as gross motor that is often preferred by males (physical theater).	• Use materials to promote sensory engagement and spatial development. • Celebrate successes in spatial tasks.
• Keep oral instructions to a minimum and post for reference. Boys will zone out with too many verbal directions or explanations.	• Offer dilemmas, puzzles, and problems that challenge perceptual learning.
• Personalize a boy's space to increase feelings of belonging (desk, locker, etc.).	• Use team learning to foster social interaction and leadership skills.
• Foster empathy and social interaction.	• Encourage participation and sharing from quieter female students.

NOTE: To read more about this, see Gurian and Stevens (2004).

Offering opportunities for movement, work with hands-on manipulatives, and a variety of seating choices (chairs, rugs, cushions) also may help the brain focus. Figure 1.7 offers an inventory that may help people identify their dominant hemisphere. This should not be used to label them but to help them become more aware of and knowledgeable about themselves.

Figure 1.7 Left Hemisphere + Right Hemisphere = Whole Brain

Circle the numbers that are most like you.

1. When I read about something new, I like pictures and diagrams.
2. I prefer step-by-step directions and to solve problems logically.
3. I get many ideas at once like "brainstorming."
4. I like to learn by seeing and hearing.
5. I remember people's faces better than their names.
6. I can control my feelings.
7. I like to create new and unique things.
8. I can recall information quickly when I need it.
9. I like to handle materials and examine things to understand them.
10. I learn new words and vocabulary quickly.
11. People would say I'm emotional.
12. I can learn easily with patience and by noticing details.
13. I picture ideas and review things in my "mind videos."
14. I like routines and have daily habits or rituals.
15. I rely on my intuition, and some people would call me spontaneous.
16. I can easily concentrate and focus when I need to.
17. I let a party "happen" and get involved with the people.
18. I plan a party down to the last detail.
19. I like to imagine new and interesting things.
20. I like true-and-false tests better than one where I have to write a lot.
21. I generally know what is going on and what everyone is doing.
22. I like to learn from the teacher.
23. I can see the whole jigsaw even though I have only a few pieces in place.
24. I can remember and describe details easily.
25. I sometimes lose track of time.
26. I usually manage time well.
27. I like group work and "catch" the mood of others.
28. I can concentrate well if I want to.
29. I like to learn by doing and touching.
30. I like to learn by listening and seeing.

____ Number of odd numbers circled.

____ Number of even numbers circled.

If you circled more odd numbers, you tend to be more right hemisphere oriented.

If you circled more even numbers, you tend to be more left hemisphere oriented.

WHOLE-BRAIN PROCESSING

Current research shows that the two hemispheres work more as a whole brain, with each one an integral part of the thinking/learning system, processing events so rapidly that they seem simultaneous. For example, the right hemisphere grasps the big picture, and the left hemisphere sorts out the details. Even the "hardheaded" thinking of the left hemisphere can be influenced by the intuition and aesthetics of the right hemisphere, resulting in a more balanced approach.

To integrate and stimulate the whole brain using each side, teachers can offer classroom activities that capitalize on both sides. For example, both hemispheres recognize words. The left hemisphere (Broca's area) interprets words and facilitates understanding by putting them in sequence and syntax. The right hemisphere relies on symbolism and the use of metaphors and analogies (one of the best practices suggested by Marzano, Pickering, & Pollock, 2001). To draw on the right hemisphere and use the whole brain, we want to use symbolism and metaphoric thinking, not just focus on conventions such as spelling, grammar, and writing.

Neuroscientist Elkhonon Goldberg (2001) offers us another theory of right-hemisphere/left-hemisphere organization. He suggests that the right hemisphere is organized to respond to new challenges and rapidly deal with situations that the brain has not previously encountered. He proposes that this is a function of the brain's survival plan that is the main purpose of the brain. A stranger's face offers unusual information that may suggest a threat. This image is quickly processed by the right side of the brain. Faces that are familiar are processed in the left hemisphere because they are not generally threatening. Both hemispheres of the brain are actively involved in most learning situations. The transfer of the information-processing function spills over from right to left when learning takes place. When we are learning new skills, the information processing is principally a right-hemisphere operation. The closer we come to mastery of a skill, processing is transferred from the right to the left side. The right hemisphere rapidly responds to new situations, but not necessarily with appropriate solutions. The left hemisphere then selects from the most promising solutions and designs strategies to be used in similar future situations.

A typical example of how this works is the acquisition of language. Youngsters may use a number of random verbal and nonverbal techniques to communicate their needs. This is a right-hemisphere job. As the child becomes more adept at communication, the left hemisphere selects the strategies that are successful and begins to construct a framework for both receiving and communicating language. It is important to use a wide range of strategies that specifically could be used for stimulating and engaging the right hemisphere and the left hemisphere. As we design learning activities that engage both hemispheres in the learning process, Figure 1.8 offers a variety of strategies worth trying.

Figure 1.8 Learning Activities That Strengthen Whole-Brain Processing

Left-Hemisphere Skills	Right-Hemisphere Skills
Keep the classroom orderly, materials and bulletin boards neat and current.	Provide multiple materials and resources.
Foster opportunities to read, write, and engage in numeracy activities.	Use hands-on experiences as well as role playing and simulations. Allow options for reading and writing.
Organize chalkboards and erase material that could become misconstrued with new material.	Use diagrams and illustrations as well as graphic organizers, charts, and timelines.
Provide agendas, expectations, and timelines.	Agendas may include visual mapping of concepts and topics of study.
Help students monitor their work, time, and successes.	Allow students to interact, discuss, and articulate their ideas.
Encourage logic and reasoning. Ask students to substantiate their thinking.	Use analogies and metaphors to help students make connections.
Encourage higher-order thinking.	Bring lessons to closure and integrate new information with past learning.

STRATEGIES FOR TEACHING TO THE RIGHT HEMISPHERE

Most classrooms are organized for and use strategies that appeal to the left hemisphere, such as concrete sequential directions, processes, and the like. To tap into the strengths of the right hemisphere and balance the thinking process, Cherry, Godwin, and Staples (1989) suggest imaging strategies, including visualization, guided imagery, and fantasy. Imaging strategies allow students to see images in the "mind's eye." This is a function of the right hemisphere and can be used to help right-dominant learners with their learning.

Visualization

Visualization is the ability to form a picture in the mind. It is visualization or visual thinking if the picture stems from the environment. It can be used for problem solving through the process of seeing the real objects or situations in the mind's eye. It sometimes helps to simplify the situation and often solves the problem. The learning may be made easier. The visualization acts as a visual aid that helps the situation.

Guided Imagery

Guided imagery starts as visualization from the environment but is taken to the next step by one's imagination. The facilitator, as to activities

and connections, makes suggestions to students. Imagination takes over, and even though things are happening only in the mind, they seem to be happening in reality. All the senses can be evoked to further the imagination. Often, this is used to help students with their self-confidence and their self-esteem.

Fantasy

Although visualization and guided imagery come from the outside, fantasy comes from within. It requires a person to create ideas no matter how far out they are. They are like daydreams that help sort out desires, thoughts, and dilemmas. Fantasy may not solve all the problems, but they provide a way for young people to articulate situations and perhaps sort out some conflict and confusion. They also act as an "escape" or at least help achieve balance. We never know where fantasies will take us. They should be nurtured, talked about, and written down in a log or journal in a free-flow form.

Ten More Strategies

1. **Connecting:** Connect the new learning to a past experience that the learner has had at school, home, or other areas of their world.
2. **Focusing:** Before the learning, discuss with the students what they are going to be studying, how the processes will unfold, and what the expectations are. There may be an agenda map with symbols and pictures.
3. **Stimulating with visuals:** Be sure to use actual objects and materials if possible. Drawings and sketches, diagrams, illustrations, and photographs enhance the learning and develop deep understanding.
4. **Vocabulary building:** Build understanding of vocabulary by using language in a variety of situations to continually reinforce comprehension and retention.
5. **Hands on:** Provide manipulatives and real materials so that students can have tactile involvement with things related to the topic they are studying.
6. **Real-world usage:** Provide a "being there" experience and help students make connections between new ideas and things in their environment and day-to-day living.
7. **Innovation:** Challenge students by inspiring and motivating them to create new ideas and methods connected to a topic.
8. **Receiving feedback:** Use feedback in the form of questions, responses, and reinforcement to support these strategies.

9. **Repetition:** Rehearse and practice guided by feedback.
10. **Transfer:** As appropriate, help students to transfer their new learning to other problems and situations.

SUMMARY

It is essential that educators pay attention to what we know about the brain. We are working with brains every day. The more we know about the brain's organization, functions, and ways of operating and processing, the more we can thoughtfully design learning for our diverse students to ensure that they understand and store knowledge and skills for future use.