FASTBACK

301

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Whole Brain Education

by
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Introduction

In 1977 Emily Luecke and I wrote fastback 108 *Education and the Brain*. Since that time I have followed the developments in the field of brain research and education and have seen many advances and changes. This fastback provides a forum for disseminating some of the new thinking in the field and for examining its implications for education.

As I have monitored the developments in brain research, I have become increasingly impressed with what the neurosciences can contribute to understanding the teaching-learning processes. When educators first became aware of brain research, it became the new educational bandwagon. I now believe it has moved beyond the trendy stage to become solid theory. The advances in the neurosciences are beginning to provide a scientific basis for teaching and learning. While these advances may not be as rapid as educators would like, they are real.

By understanding brain functioning, teachers can open the world of learning to more students through alternative pathways of the brain. I will explore these alternative entry points to the brain in this fastback (particularly the visual and nonverbal) and suggest classroom applications. Some of the background on brain research presented here is taken from my book *Teaching and Brain Research: Guidelines for the Classroom* (1984).

It is my hope that this fastback will contribute to educators' understanding of brain functioning and will stimulate others to contribute to the emerging field of whole brain learning.

Why Study the Brain?

According to Alfred North Whitehead (*Modes of Thought*, 1938, p. 1), "The first chapter in philosophic approach should consist in a free examination of some ultimate notions, as they occur naturally in daily life." One of the "ultimate notions" for teaching and learning is how the brain functions. We know that learning occurs in the brain; yet until recently, we had little understanding of how the brain functions. For example, researchers are not certain how a person remembers, but consider how important the function of memory is to much that we ask children to do in school. If neuroscientists can help educators understand basic brain functioning and its implications for teaching and learning, they will have provided a basis for the science of teaching.

Teachers may well ask if the study of brain functioning has any relevance to what they do in the classroom. Admittedly, there have been enough spurious extrapolations from limited neuroscientific evidence to cause teachers to be skeptical. But the potential that brain research holds for teaching and learning is too important to ignore. Brain research is a multidisciplinary field requiring input from many groups. One of these groups is educators, who bring a unique perspective for exploring the mysteries of human beings' most complex organ.

The brain's complexity can be intimidating to many people, who think they have to be a neurologist to even begin to comprehend it.

Yet teachers are in a position to observe the brain in operation as they work with children every day in the classroom. Perhaps no one knows more about how a child learns than a first-grade teacher who spends six hours a day, 180 days of the year with 25 inquisitive six-year-olds. This teacher's classroom is a virtual laboratory for making naturalistic observations about how the brain functions. Therefore, teachers should consider themselves members of the multidisciplinary team involved in unraveling the secrets of the brain.

Brain Research and Learning Styles

Only in the last part of this century have researchers studied the brain extensively. Their work has not only given us insight into mental illness but also about how children learn and remember. Some of their most interesting work has been in the area of hemispheric specialization (see fastback 108 *Education and the Brain*). The brain hemispheric theory states that people have two ways of processing information: linearly (using language and logic) and holistically (using nonverbal, visual, and kinesthetic modes).

This research helps to explain the differences in learning styles, about which much has been written in recent years. We know, for example, that students' learning styles differ according to their age and the nature of the subject matter they are studying. We also know that some children have a dominant learning style. Recognizing that there are a variety of learning styles does not mean that a teacher simultaneously must accommodate 25 different learning styles in a classroom. Rather, it means that they should help students to use the learning style that is appropriate to the learning task. This calls for a multimodality approach to teaching.

Historically, the dominant mode of teaching has been linear with its emphasis on language and logic. In this fastback I will make a case, based on brain research, for expanding the modes of teaching in order to enhance learning and achievement. Specifically, I will focus on how students can think and learn using visual and nonverbal activities. Further, I will suggest methods that expand on traditional notions of intelligence and use brain compatible strategies that move beyond logic and language.

In *The Man Who Mistook His Wife for a Hat and Other Clinical Tales* (Summit Books, 1985), Oliver Sacks, a professor of clinical neurology, presents a case study that serves as an example of how alternative pathways of the brain can lead to different kinds of learning. Rebecca, a 19-year-old referred to Sacks, was diagnosed as mentally defective. She had left-right confusion, was clumsy except when dancing, exhibited degenerative myopia, and was withdrawn; but she was capable of warm and deep attachments. Rebecca was removed from the workshop, which she hated, and entered a special theater group. In this creative environment "she became a complete person . . . and one would never even guess that she was mentally defective" (p. 176).

In his postscript to Rebecca, Sacks states:

> What we see, fundamentally, is the power of music to organize – and to do this efficaciously (as well as joyfully!) when abstract or schematic forms of organization fail. Indeed, it is especially dramatic, as one would expect, precisely when no other form of organization will work. Thus music, or any other form of narrative, is essential when working with the retarded or apraxic – schooling or therapy for them must be centered on music or something equivalent. And in drama there is still more – there is the power of *role* to give organization, to confer, while it lasts, an entire personality. The capacity to perform, to play, to *be* seems to be a "given" in human life, in a way which has nothing to do with intellectual differences. One sees this with infants, one sees it with the senile, and one sees it, most poignantly, with the Rebeccas of this world. (p. 177)

The case study of Rebecca establishes a theme for this fastback: developing enlarged concepts of teaching and learning based on investigations of brain functioning. The findings of these investigations will help educators better understand how children learn and will begin to answer the question that has intrigued scholars for centuries: How does the brain think about itself and learn?

As educators begin to explore the full potential of the brain, they will find ways to assist students, who in the past might have been considered slow, unmotivated, apathetic, or to have other kinds of learning problems.

Early Beliefs About Brain Functioning

In this chapter I present a summary of some early beliefs about brain functioning in order to establish a context for understanding current thinking based on brain research.

Philosophers have had a fascination with brain functioning since ancient times. A common interest was trying to determine the location of the mind in the body. It was once believed that the mind was located in the heart or the liver. The ancient Greeks had other ideas about brain functioning. They believed, for example, that certain body fluids (humors) influenced one's mood. An excess of bile caused a person to be angry; an excess of phlegm caused a person to be very calm, hence the term phlegmatic. Although such notions are now rejected, researchers today are studying neurotransmitters in the brain to see if they influence temperament or mental states.

Galen, the ancient Greek physician, examined the structure of the brain by dissecting heads of animals. Galen believed that the brain was the center for thought and action, not the heart, as many Greeks believed. His ideas were not influential among his contemporaries and were not explored further. In fact, for centuries many scholars (and poets) continued to believe that the heart was the repository for thoughts and feelings.

By the eighteenth century several so-called "sciences" had developed that sought to explain mental functioning and personality traits. One of these was physiognomy. Although not dealing directly with the brain, it purported to determine personality traits by studying facial and head characteristics. This "science" was made popular in the eighteenth century by the writings of John Lavater. In his "scientific" treatises one found such statements as a low forehead and a thick neck indicate stupidity, whereas a high forehead indicates intelligence.

More directly related to the brain was the "science" of phrenology. Phrenology, developed by Franz Gall in the late eighteenth century, purportedly could determine a person's character by the shape of one's head. Different parts of the brain were supposedly the repository for different personality characteristics. Gall contended that persons with certain bumps on their heads had certain qualities. He observed the heads of students and thought that he could feel the "organ" of number in mathematicians, the organ of melody in musicians, or the organ of rhyme in poets. He also thought that a certain bump made people thieves or murderers. Today, we know that Gall's theory is false. We know we cannot even tell the shape of the brain by touching bumps on the head because the brain is completely encased under the skull. We also know that such emotional functions as love, anger, and hate, which Gall claimed are located in certain parts of the brain, are not located in one specific area.

Epilepsy presents another interesting historical example of notions about brain functioning. Most ancient Greeks thought epilepsy was a divine disease imposed on a person by the gods. Galen offered a more plausible, although erroneous, explanation, when he said that seizures were caused by the stagnation of phlegm and black bile within the cavities of the brain. Later thinkers thought that epileptic seizures were somehow related to phases of the moon, with more seizures occurring during a full moon. During the Middle Ages epileptics were burned to death as sorcerers. In early Colonial America, it is reported that epileptics were burned at the stake because it was thought they were possessed by the devil.

It was not until the seventeenth century that brain dysfunction was accepted widely as a cause of epilepsy. Research continues today to discover what in the brain causes some persons to have seizures and others not to have them. Current investigations of the architectural and chemical-electrical operations of the brain may someday provide an accurate explanation.

Today we dismiss these early beliefs and pseudosciences and poke fun at them. Actually, some of them did provide direction for future research and gave us some new knowledge, however rudimentary. And who is to say whether current research on brain functioning might someday be proved wrong, or at least incomplete.

Down through history scholars have attempted to explain the mysteries of the brain metaphorically. In ancient times the heart was thought to be the center of mental and emotional functions. In more recent times the telephone switchboard with its multiple connections was a favorite metaphor. Today, we compare the brain to a computer. None of these metaphors truly captures the complexities of the human brain. But current research is providing some fascinating insights into brain functioning, a topic to which we now turn.

Current Concepts of Brain Functioning

Once scientists overcame the prejudice that it was impossible for the brain to understand itself, they began to use such technological innovations as instruments that measure brain waves, sophisticated X-rays, and chemical analyses to investigate brain functioning. Along with these technological advances, which greatly advanced the study of brain functioning, there developed the interdisciplinary field known as psychobiology. This field, which incorporates brain research and the behavioral sciences, may ultimately provide answers to some of the fundamental questions in teaching and learning.

It is beyond the scope of this fastback to provide an in-depth discussion of brain functioning. (Readers interested in pursuing the topic further should consult the references listed at the end of this fastback.) However, Richard M. Restak in *The Brain: The Last Frontier* (1984) suggests a helpful way of understanding the operations of the brain. He divides brain functioning into three major components: alertness, information processing, and action. It is the interaction of these three components that causes the brain to function. The brain also contains an electrical system, which can be traced on an electroencephalogram, and a chemical system composed of neurotransmitter chemicals that either transmit or block the electrical impulses. The brain is simultaneously conscious of its existence and adaptable to it. In this two- to three-pound grayish lump of tissue are generated dreams, feelings, and learning.

Hemispheric Specialization

Probably the most widely known and discussed concept of brain functioning is hemispheric specialization, or as it has become popularly known, left-brain and right-brain functioning. This concept initially became something of a buzz word among educators and led to some arbitrary and capricious claims being made about the functions of the two hemispheres. There appears, though, to be fundamental differences between the two hemispheres that have implications for teaching and learning. A brief explanation of the differences follows.

Early researchers in hemispheric specialization were Roger Sperry and Joseph E. Bogen, whose work involved efforts to alleviate uncontrollable seizures in epileptic patients. When traditional means of treating these patients failed, Bogen experimented by severing the corpus callosum, the nerve fibers that connect the two hemispheres of the brain. Following surgery, in most cases the seizures were less severe and patients could be treated by epileptic medication. This surgery, which is rarely used today, was just the beginning of research on the hemispheric functions of the brain.

It has been determined that the two spheres of the cerebrum, while seemingly alike, serve different functions. The right hemisphere controls the motor and sensory operations of the left side of the body, the left hand, and half of each retina. The left hemisphere controls the same operations on the right side of the body. The corpus callosum connects the two hemispheres and integrates their operations. In addition, each hemisphere specializes in a particular mode of consciousness. From experiments with patients who had their corpus callosum severed, as well as with patients who suffered brain damage, researchers have hypothesized that a person has two ways of processing stimuli and that each of these seem to stem from a separate hemisphere. Sperry, who won the 1981 Nobel prize in medicine for this work, stated:

> Instead of the normally unified single stream of consciousness these patients behave in many ways as if they have two independent streams

of conscious awareness, one in each hemisphere, each of which is cut off from and out of contact with the mental experiences of the other. In other words, each hemisphere seems to have its own perceptions; its own concepts; and its own impulses to act, with related volitional, cognitive, and learning experiences. (1968, p. 724)

The left hemisphere specializes in linear, sequential, and analytic operations, whereas the right hemisphere specializes in simultaneous holistic and visual-spatial operations. Based on these findings, educators are speculating that each hemisphere operates in a different cognitive mode, which may be helpful in understanding teaching and learning processes. Sperry (1985) speaks to this point:

> One important outcome is the increased insight and appreciation in education and elsewhere, for the importance of nonverbal forms and components of learning, intellect, and communication. By the early 1970s it already had become evident, from a standpoint of brain research, that our educational system and modern urban society generally, with its heavy emphasis on linguistic communication and early training in the three Rs, tends increasingly to discriminate against the nonverbal half of the brain, which has its own perceptual-mechanical-spatial mode of apprehension and reasoning. The amount of formal training given to the right hemisphere functions in our public schools traditionally has been almost negligible, compared to that devoted to the specialities of the left hemisphere. (p. 18)

Keeping Sperry's point in mind, we must remember, however, that the normal brain functions with both hemispheres operating. Learning school subjects is neither solely left- nor right-brain activity, nor can they be taught solely in a left- or right-brain mode. Different subjects and tasks require different types of cerebral functioning.

Visual Functioning

Another area of research that initially came from the split-brain studies relates to the differences between visual imagery processing and language processing. Michael Gazzaniga, who worked with Roger

Sperry, examined patients whose corpus callosum had been severed. In his recent book, *Mind Matters* (1988), Gazzaniga describes how these patients responded to images shown either to the right or left sides of their visual field. In the normal brain, a picture shown to either side is quickly identified because of the connection between the hemispheres provided by the corpus callosum. But in the split-brain patients, Gazzaniga observes:

> A picture presented to the right of the point is quickly named, just like in a normal person, because the information is projected to the normally dominant left half brain, the seat of language and speech. The left brain sees the picture and easily describes it. When the picture is presented to the left of the fixed point, however, the split-brain patient is unable to identify it. The image is projected to the right brain and remains isolated in that nondominant hemisphere as a consequence of the disconnecting callosal surgery. The right brain cannot talk; only the left can. As a result, the patient says (this is the left brain talking), "I didn't see anything." And this is true: the left brain didn't see anything. The only way the right brain can indicate it knows something about the stimulus is to point to a matching or related picture. If a picture of an apple had been flashed to the right brain, the patient, while not being able to talk about it, could pick out another apple picture from a group of pictures. (p. 12)

This research has implications for teaching and learning with respect to nonverbal functioning of the brain.

The Visual Brain

The brain is enormously complex; the functions of its parts cannot be broken down into discreet operations. In normal persons it operates as a functioning whole. Yet, as the experiments described above demonstrate, hemisphere specialization does occur. These experiments have enriched the understanding of brain operation. Remember, though, researchers are speaking about specialization, not total exclusiveness. Both hemispheres can learn the functions of the opposite hemisphere, at least to some extent. The point for educators to take from this research is the nonverbal processing of information as one alternative pathway of the brain.

Gazzaniga also conducted studies with normal subjects. Using anesthetics, he was able to put one side of the brain asleep while providing information to the other. He discovered that the left brain could not "talk" about information that had been fed into the right hemisphere. But if the right hemisphere is given an opportunity for expression, usually by pointing to an array of possible choices, its response was always right on target. "In short, we had collected data that revealed that even within the normal brain, the right hemisphere possessed knowledge that was encoded in a form that remained insulated from the search process of the left hemisphere's language system," says Gazzaniga (quoted in Restak 1984, p. 256).

Restak goes on to say that the brain may have a number of mental units that have memories and emotions and can express themselves. However, these units "may not be in touch with the verbal system at all but rather, have their own existence outside of the areas of our brain responsible for our language and our logic" (p. 257).

From the research summarized above, it appears that the brain processes information in other ways than through logic and language. These new pathways of the brain are expanding our definitions of intelligence and learning in school. It is to the schools' response to these significant findings that I now turn.

Knowledge Beyond Language

In this section I examine some current notions about multiple intelligences. I will argue that educators need to expand their definitions of intelligence and to adopt instructional strategies that move beyond the language emphasis in most classrooms to include the nonverbal and visual functions of the brain.

I begin with some examples that contrast the language emphasis in learning with nonverbal and visual modes of learning. My point here is not to minimize the importance of reading and writing in the educative process, but rather to suggest a more balanced instructional approach using all pathways to the brain, not only for those who have problems with reading and writing but, indeed, for all children.

Typically, the first thing that happens when one starts a new course is that the instructor begins the class by introducing the textbook and often passes out a reading list. The assumption is that the way to learn, at least in school, is by reading about the subject. For good readers, this presents few problems. But the poor or non-reader will almost certainly fail. This failure does not indicate a lack of intelligence necessarily, but rather that the instructional mode is not appropriate. Consider, for example, how much five-year-olds know when they come to kindergarten. They have learned many complex tasks and concepts without ever having read a word and without ever having completed a worksheet.

Expanding on the reading example, when my car does not start in the morning, I feel completely helpless and have no idea of what action to take. So I get my car towed to my mechanic, a high school dropout. He performs what to me is a miracle. He tinkers, he listens, he uses sophisticated instruments to test various motor functions. He was not successful in school, but he possesses a certain kind of intelligence – one that was not valued by the traditional school culture. And if he spells carburetor incorrectly on my bill, it is not important to me because my car is now running. My mechanic has performed successfully.

Another example is a friend who is a carpenter. He also was not successful in high school. He does, though, have a knack for visualizing things. He sees the design of his construction in his head. His customers know this when he completes a project and it looks like he said it would. Sometimes he sketches something on paper when he needs to communicate to his non-visual clients, like me. Here is another case of a person who uses a form of intelligence that received little support in his school.

The art curriculum presents another example of the failure to acknowledge alternative modes of intelligence. In my school experience, art activities were used mostly as a form of reward. More than one of my teachers said, "If you boys and girls will be good all week, then on Friday afternoon I will let you draw." Granted, the art education curriculum has improved tremendously since I was in elementary school; but the fact remains that when a school district faces budget constraints, one of the first things to go is the art program. Again, my point is that low priority is given to nurturing visual intelligence.

One need only read a list of high school graduation requirements to see what forms of intelligence are valued in school. How many years of mathematics and science are required for graduation compared to art or dance? How many years of English composition are required compared to a course in visual media? When one looks at what methods of processing information are important in order to graduate from high school, it becomes clear that the balance is tipped toward language and logic as the preferred mode of learning.

Multiple Intelligences

The concept of multiple intelligences has been investigated by several researchers, notably Howard Gardner in *Frames of Mind: The Theory of Multiple Intelligences* (1983). Gardner argues that there are several domains of intelligence not all of which are valued in school, as the previous examples illustrate. In addition to language and logic intelligences (associated with traditional school learning), Gardner identifies musical intelligence, spatial intelligence (skills for analyzing the visual world), physical intelligence (movement, dance, and athletic skills), intrapersonal intelligence (skills associated with self-understanding), and interpersonal intelligence (skills associated with understanding of and empathy for others).

The theory of multiple intelligences is not without its critics. For example, Robert Sternberg in *The Triarchic Mind* points out that naming intelligences is not the same as explaining the underlying processes of how these intelligences function. Further, Sternberg suggests that what Gardner identifies as intelligences might be better called talents because of their specialized nature. Whether we call them intelligences or talents, the theory of multiple pathways in brain functioning should cause educators to examine their instructional strategies in order to reach all students, not just those who are language oriented. As Gardner says, the adoption of a theory like multiple intelligences "may permit a more differentiated and precise analysis of how various educational goals might be viewed and pursued" (p. 373).

Visual Learning

If we accept the premise of the theory of multiple intelligences, then we need to consider what instructional strategies are appropriate for tapping the various types of intelligence. A good place to begin is visual learning or, more specifically, visual information processing, which, as we have learned, occurs in the right hemisphere of the brain.

Educators became aware of the importance of visual learning some years ago with the advent of the visual literacy movement. Advocates in this movement were promoting the use of visual media in classrooms. Their case gained support from the research on right hemisphere visual information processing. Such processing not only contributes to visual literacy but is helpful in many areas of study.

In an interesting report in *Brain Mind Bulletin* (8 July 1985), Robert Root-Bernstein points out how the arts in general and specifically the visual arts can assist scientists: "It's about time the contributions of the fine arts to science and technology are recognized and used. . . . It is not just that a scientist *is* an artist, but that he works as an artist when he does science."

In his study of the biographies of 150 scientists, Root-Bernstein concluded: "Experiments alone cannot produce conceptual breakthroughs. . . . One must first be able to imagine that which is to be tested and how to test it." The ability to imagine requires modeling, analogizing, and pattern forming -- all visual activities. By first approaching a problem visually, the scientist builds a mental construct that later can be translated into some verbal or mathematical form. "The ability to translate between modes of intelligence may be a key," says Root-Bernstein.

In many sports, coaches advocate using visualization techniques to improve their athletes' performances. Coaches have learned that verbal instructions may actually distract athletes from improving their performance, whether it be a golfer's hitting the ball, a swimmer's stroking, or a figure skater's freestyle routine. Coaches have learned that better and faster results can be obtained through visualization techniques.

Closely related to visualization is the use of imagery. In imagery you learn to relax and imagine a situation that you would like to be real. Ornstein and Sobel discuss in *The Healing Brain* (1987) how imagery has been employed to help healthy persons to stay well and to help sick people become well again. In education, imagery has been used as a relaxation technique, for preparing students to take tests, and for various forms of self-affirmation. Experiencing the imagery of poetry is another example of classroom visual learning.

The visualization potential of the brain is just beginning to be explored. As educators learn more about it, they will find new ways of using it to complement the verbal and logical modes for teaching and learning in all subjects. Albert Einstein serves as an example of a creative mind who integrated visual processing and logical reasoning. Einstein reported that he often drew pictures or diagrams in order to create models in his mind that would help him as he formulated his revolutionary theories.

The next chapter will expand on instructional approaches that employ, like Einstein, visual processing and logical reasoning in order to challenge the whole brain.

Whole Brain Instructional Strategies

Whole brain instructional strategies presented here were selected based on their compatibility with brain research. However, at the outset let me state that I do not believe that there is one right way for all teachers to teach all of the time. Rather, I believe that teachers should have a repertoire of instructional strategies to draw on depending on the instructional purpose, the nature of the subject matter, the developmental level of students, and the preferred learning style of students.

Characteristics of whole brain learning include:

1. Expanding the modes of information processing beyond the dominant language/logic modes.
2. Selecting appropriate pathways to the brain in order that all children can succeed.
3. Providing flexibility for students to move in and out of various modes of learning and thus use their multiple intelligences.

With these characteristics in mind, let us now examine some strategies for whole brain learning.

Identifying Visual Learners

By focusing attention on visual processes in the classroom, a teacher can quickly assess whether a child is dominantly a visual learner, often-times called a "right-brain" student. Characteristics of the visual learner include nonverbal modes of expression; intuition; imagination; interest in spatial relationships, shapes, and patterns; and sensitivity to color and art.

A teacher can use various methods to screen for these characteristics in students. For example, Barbara Meister Vitale in *Unicorns Are Real* uses a set of questions to screen for visual dominance. Some sample questions she uses are:

1. I want you to see your favorite ice cream cone in your head. Where do you see it?
2. Listen inside your head. I want you to hear your favorite song, bird singing, or waves hitting the beach. Where do you hear the sounds?
3. Here is a new word. The word is ____________. How did you learn it?
4. How do you remember what your mother/teacher wants you to do?

In her book Vitale presents interpretations of children's responses to such questions, which help a teacher determine if a child is a visual learner. Other types of questions that can be used in assessing visual dominance are:

1. Imagine the center of your back is itching. Which hand do you use to scratch it?
2. Wink at an imaginary friend in front of you. Which eye does the winking?
3. Tilt your head over onto one shoulder. Which shoulder does it touch?
4. When going to an unfamiliar place, would you rather have verbal directions or a map?
5. Do you like to write poems?
6. Can you visualize an object in your head?

As teachers become more aware of the many pathways to the brain through which children learn, they will also become more perceptive observers of children and how they learn. By combining classroom observations and interpreting responses to the kinds of questions presented above, a teacher has a much better grasp of a student's dominant learning style. With this information, a teacher might begin to develop instructional strategies that are more appropriate for visual-spatial modes of thinking.

Visual-spatial modes of thinking need not be restricted to visual learners. All students can profit from visual learning experiences. As Launa Ellison states in *Recent Brain Research and Its Educational Implications*, "Visual-spatial thinking can be integrated into all subject matter, it is not the domain of the art specialist alone." Students can make visual journals, enlarge small pictures, and create images of abstract concepts. They can construct models of a city of the future. Visual literacy can be taught by analyzing advertisements or illustrations.

As Rudolph Arnheim points out in his seminal work, *Visual Thinking* (1969), the use of visuals can enrich almost any learning experience. Classroom examples include showing pictures to young children before, during, and after reading activities to associate language with visual experiences. Math and science problems can be turned into visual games. Using manipulatives of all types helps children visualize concepts in a concrete way. Classroom computers with their vivid color graphics are another way of stimulating visual learning.

Visualization techniques can be used in the teaching of spelling. Children can write spelling words on the chalkboard, close their eyes and "see" the word, or even write the word with their foot adding a kinesthetic dimension. For some visually oriented students, it helps to have them practice their spelling words using a flashlight as a writing instrument.

Music, which usually is studied in a sequential and logical manner, can also be used to stimulate visual imagery. The combination of music and visuals to create a slide-tape show can be a powerful communicator and helps with retention.

In addition to visual instructional strategies described above, there are other whole brain strategies involving physical movement. Dance, pantomime, and other free-movement activities are excellent nonverbal methods of communicating. Students can develop stories through pantomime; they can express emotions through dance and free movement. A good source to consult on this topic is Paul Dennison's *Brain Gym*.

In addition to classroom directed visual activities, there are opportunities for visual learning in homework assignments, student reports, and projects. Teachers can suggest alternative assignments that require visual presentations. Students can prepare reports using a video camera, which the entire class can view and react to.

In *A Place Called School* (1984) John Goodlad reports on his massive study of schooling in America. His conclusions about what he and his associates saw in typical elementary classrooms across the country are particularly pertinent to our discussion of whole brain learning.

> they [teachers] tend not to see manual activity as both intimately connected with the mind and an alternative mode of learning. Arts and crafts tend to become supplemental, a relaxed, undemanding relief from the reading, writing, and arithmetic that really count, but of little value in themselves. Learning becomes a one-way street, heavily dependent on symbols and the manipulation of symbols and not on things, the manipulation of things, and relating these things to symbols.
>
> Those children who appear to relate most readily to the manual model and least readily to linguistic and numerical symbols often are those judged as poor and slow learners. Their manual propensities are viewed more as evidence of a nonacademic bent than a fruitful, alternative avenue to be utilized in learning to read, write, spell, and compute. And our data show a decline in the modest use of alternative teaching approaches observed in the primary grades with advancement to the higher grades. (pp. 142-143)

Some of the "alternative teaching approaches" Goodlad is referring to are precisely the ones suggested in this chapter. They are approaches based on new understandings of brain functioning. They are whole brain methods that emphasize visual learning. Balancing the dominant verbal instructional mode with the strategies discussed here provides entry points to the diverse pathways to the brain, which can enrich the learning of all students.

Final Thoughts

The brain is where learning takes place. As educators learn more about how the brain operates, they can develop instructional strategies that are compatible with brain functioning. New knowledge about brain functioning may be even more useful in helping those students who have had learning problems in the past.

Brain research is not a panacea for all of education's ills, but neither is it a fad. As this fastback has documented, the research on brain functioning has resulted in teachers expanding their instructional repertoire to include nonverbal and visual strategies. And as new research appears, educators will develop other promising approaches to learning that use all the pathways to the brain.

Further Readings

The following sources, with annotations, will be helpful to educators interested in pursuing the ideas discussed in this fastback.

Arnheim, Rudolf. *Visual Thinking*. Los Angeles: University of California Press, 1969.

A major early work that describes visual thinking and its role in education.

Brain Mind Bulletin. Interface Press, Box 42211, 4717 N. Figueroa Street, Los Angeles, CA 90042.

A monthly publication, edited by Marilyn Ferguson, it digests current research in areas related to the brain.

Dennison, Paul E. *Brain Gym*. Glendale, Calif.: Edu-Kinesthetics, 1986.

This brief book presents activities and body movements that contribute to whole brain education.

Ellison, Launa. *Recent Brain Research and Its Implications*. 3348 47th Avenue, S. Minneapolis, MN 55406.

Ellison also publishes a quarterly newsletter that teachers using whole brain strategies will find helpful.

Gardner, Howard. *Frames of Mind: The Theory of Multiple Intelligences*. New York: Basic Books, 1983.

Gardner's theory of multiple intelligences has been influential in expanding traditional concepts of teaching and learning.

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