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Brain laterality and education

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Abstract

Although the brain functions as a whole unit with both sides being active, there are areas of specialization within the brain. Research indicates that the human brain is composed of two hemispheres, which are capable of functioning independently of one another. According to Michael Gazzaniga (1983), the left hemisphere is responsible for linear, symbolic, sequential and verbal thought. The right hemisphere is responsible for holistic, concrete, random and pictorial thoughts. The left can be compared to a computer while the right is more creative and intuitive. Individuals tend to develop a preference for using one side over the other, although at no time is only one brain half used. Madeline Hunter (1976) believes education focuses primarily on left-brain dominant students, leaving a vast reservoir of brain power untapped. The best educational methods are those that teach as many students as possible via techniques and strategies that reach all types of learners.

Brain Laterality and Education

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ABSTRACT

Although the brain functions as a whole unit with both sides being active, there are areas of specialization within the brain. Research indicates that the human brain is composed of two hemispheres, which are capable of functioning independently of one another. According to Michael Gazzaniga (1983), the left hemisphere is responsible for linear, symbolic, sequential and verbal thought. The right hemisphere is responsible for holistic, concrete, random and pictorial thoughts. The left can be compared to a computer while the right is more creative and intuitive. Individuals tend to develop a preference for using one side over the other, although at no time is only one brain half used. Madeline Hunter (1976) believes education focuses primarily on left-brain dominant students, leaving a vast reservoir of brain power untapped. The best educational methods are those that teach as many students as possible via techniques and strategies that reach all types of learners.

CHAPTER I

Introduction

There is currently a high interest in laterality of the brain and its implications toward teaching and learning. The past 25 years have yielded more information about the brain than all the preceding years. In order to apply this information to teaching and learning theories, some basic knowledge in brain geography is necessary.

The brain is a simple looking organ weighing about three pounds. It appears to have a fissure or crack running through the center which divides it into two hemispheres. The corpus callosum and the anterior commissure are bundles of nerves that serve as a communications system between the two hemispheres. Although the two hemispheres appear pretty much the same, their functions are quite different.

The left hemisphere is our "computer." It takes care of information by way of ordered, sequential, logical and analytical reasoning (Cole, 1980). Broca's area and Wernicke's area (the two areas responsible for language) are located here (Geschwind, 1979). Some of the academic specializations of the left hemisphere include handwriting, symbols, speaking, reading, phonics, locating details and facts, talking and reciting, following directions, listening and auditory association (Vitale, 1982).

The right hemisphere is our creative element. It is believed to be responsible for intuitive, holistic, non-judgmental thinking, which leads to expanded consciousness, increased awareness, divergent thinking and feeling, creative perception, and synthesis of experience (Cole, 1980). Some of the academic specialization skills associated with the right brain are haptic awareness, spatial relationships, color sensitivity, singing and music, art expression, creativity, visualization, feeling, and emotions (Vitale, 1982).

There appears to be two opposing points of view concerning the legitimacy of brain laterality. Michael Gazzaniga (1985), who has conducted extensive research on the commissurotomy patients, believes people do develop a preference for using one side of the brain. However, another popular point of view is presented by Jerre Levy (1985). She strongly believes brain laterality is a myth.

Can each brain half operate independently of one another? Is it possible for individuals to develop a preference for using one hemisphere over the other? If one believes that learners do develop a preference for one side of the brain, is it possible for instructors to develop materials and a teaching style to accommodate both types of learners? The purpose of this paper is to explore these questions and examine possible answers.

CHAPTER II

Review of Literature

History

Many people in history have been aware of the two distinctly different thought processes. Freud originated the concept of the conscious, the left hemisphere, and the unconscious, the right hemisphere (cited in Blakeslee, 1980). Because the two hemispheres store information differently, the memory of one hemisphere is not readily available to the other.

Michael Gazzaniga (1985) proved this theory using the Wada procedure, in which one side of the brain is anesthetized. Since the two halves of the brain are fed through separate arteries, a sedative can be injected into one side or the other. By observing one hemisphere at a time, specific activities controlled by that side of the brain can be determined.

Gazzaniga (1985) cited the case of a patient who had had his left hemisphere anesthetized. The left hand was mobile because the right-brain was awake. Gazzaniga placed a spoon in the speechless person's left hand, and asked him to remember it. After about 30 seconds, he removed it. A few minutes later the patient began to regain consciousness. Gazzaniga said, "I placed something in your left hand while you were asleep. Can you tell me what it was?" The patient looked puzzled and denied anything had been placed in his left hand. Gazzaniga continued to probe, "Are you sure you can't remember anything I gave you a few minutes ago?" Once again, the patient denied having anything. Gazzaniga showed the patient a group of objects, and with decisive speed, the patient pointed to the spoon. The information was there in the right brain the entire time, but it was unable to communicate the information to the left side. So the theory was proven accurate in the respect that the right hemisphere has a storage of information not always accessible through the language speaking left hemisphere.

One man who was quite aware of his "illiterate" yet creative hemisphere was Albert Einstein (Blakeslee, 1980). According to Blakeslee's book, Einstein said that words did not play a role in his thought process. He thought in pictures and not in words. In other words, he visualized his ideas.

Sometimes the left brain interferes with right-brain logic. When attempting a physical activity, such as golf, concentration in the right brain is necessary. If things don't go according to plan, the left brain is there to advise and criticize. Mozart had such conflict between his left and right brains that as he wrote out a score of music, he would have his wife read to him to occupy his mind so the notes would come more freely (Blakeslee, 1980).

Research

Our modern understanding of the brain began in the 1950s with Roger Sperry and his experiments on split-brain animals. In the 1960s, neurosurgeons began performing operations known as cerebral commissurotomies on epileptic patients (Restak, 1984). The procedure involves cutting the corpus callosum and the anterior commissure (the communications system between the hemispheres). The result is a person whose brain operates as two separate entities; yet, it has little effect on the patient's functioning (Sperry, 1975). In 1967, Roger Sperry and Michael Gazzaniga began follow-up studies on commissurotomy patients.

The analysis of each half-brain function is observable through the visual sensory system. When a point is fixed in space, all visual information to the right of the point is exclusively projected to the left half-brain. Information presented to the left of the fixation is projected to the right half-brain. In 1982, Jay Myers and Roger Sperry developed a visual test that does not make use of tachistoscopic devices (a device that physically separates the field of vision). With this method, no partition is needed to divide the visual fields as with tachistoscopic devices. Instead the limits are based on how far the eye can rotate (Myers & Sperry, 1985). This improved the method of testing visual stimuli because it allowed researchers to control the timing of the presentation.

Touch information is also lateralized. Information coming from the right hand is projected to the left hemisphere, and information coming from the left hand goes to the right hemisphere. This makes separate testing of the hemispheres possible. In other words, what the left hand touches goes to the right hemisphere and what the right hand touches goes to the left (Gazzaniga, 1983).

One classical split-brain experiment consists of a subject staring at the center of a screen. A word or picture is flashed to one side or the other. Follow-up studies of the stimulus determine how much information is stored and transferred from one hemisphere to the other. Roger Sperry wrote ". . . it is most impressive and compelling to watch a subject solve a given problem like two different people in two consistently different strategies -- depending on whether he is using his left or right hemisphere" (cited in Blakeslee, 1980, p. 32).

One experiment conducted by Sperry compared the geometric abilities in five split-brain patients. Each half of the brain was tested separately using the sense of touch in relation to shape recognition. The more difficult the shape, the wider the gap between left hand and right hand scores. When curved figures were used, left hands (right brains) scored 86 percent while right hands (left brains) scored 33 percent (Blakeslee, 1980).

Additional hemisphere specialization research has been done in the area of brain damage victims. Brain activity can be monitored through modern technology: recordings of brain electrical activity (electroencephalograms or EEG's), mapping the blood flow patterns in the brain (regional cerebral blood flow), and a technique known as positron emission topography (PET scan), which provides images that reflect brain metabolism in different regions (Restak, 1984). Patient behavior, activities, and abilities are matched with brain scans to obtain further specialization information. The amazing discovery in this area has been the difference in pliableness of the brain. Young children (less than five years of age) can have the left hemisphere completely removed and still develop normal language ability. But an adult who suffers injuries to the language centers of the left hemisphere has little or no hope of speech recovery (Restak, 1984).

Normal brains can also be researched for brain specialization. One method is the previously mentioned Wada procedure, where half of the brain is anesthetized. Listening tests are also a good indicator of cerebral dominance. If, for example, different words are simultaneously dictated to both ears at the same level, the right ear (left brain) will dominate. If nonsensical sounds are presented simultaneously, the effect is reversed and the left ear dominates (Blakeslee, 1980; Lewandowski, 1982; Restak, 1984). EEG recordings are also a powerful tool in observing electrical activities of the brain. Generally speaking EEG recordings cannot detect specific activity, but generalizations can be made. Eye movement studies have also been shown to be somewhat reliable. Raquel and Rubin Gur of Stanford University asked 49 students verbal and spatial questions while a hidden camera recorded eye movements (cited in Blakeslee, 1980). It was found that eyes moved to the right 64 percent of the time after verbal questions but only 31 percent of the time after spatial questions.

Laterality imbalance has been shown to have genetic, cultural and environmental links. Males are more likely to be right-brained than females. Late maturing individuals are more likely to develop a laterality imbalance than early maturing individuals (Kimura, 1985). A parent can influence brain development by altering the stimulus in an infant's surroundings -- toys, conversation, activity level, and so on (Restak, 1984).

One study showed that laterally inverted mirror image forms are more readily confused by elementary children than up-down mirror-images (Fehn, Streicher, Ettinger, & Brown, 1985). The study went on to show that children who were blind since birth had fewer problems distinguishing mirror pairs by touch than sighted children of the same age. One conclusion which might be drawn from this is that brain development of sight laterality occurs at a later time than touch laterality. Human brain development was then compared to brain development of the rhesus monkey. Whereas in the monkey brain the representation of spatial direction (left/right) is the same for visual and for tactile inflow, in the human brain, visual and tactile directions are not aligned with respect to one another.

Marian Diamond has done extensive research on laterality in rats and has found that testosterone can allow areas of the right hemisphere to grow larger (cited in Garmon, 1985). Although direct correlations between rats and humans cannot be made, some interesting relationships can be seen. Dr. Camilla Benbow (1986), Professor of Psychology at Iowa State University, has studied several hundred thousand intellectually talented 12 to 13 year old students over the past 15 years through the Scholastic Aptitude Test. She has discovered sex differences consistently appear in mathematical reasoning ability . . . favoring males. She has concluded that sex differences in SAT-M scores among intellectually talented students result from both environmental and biological factors. Benbow suspects that high levels of the male hormone testosterone, present in a mother's body during pregnancy with a male fetus, may damage one side of the brain, making the other side which controls most math skills, stronger.

An example of laterality imbalance can be found in the Japanese culture. They have two systems of writing -- one is phonetic and the other is pictorial. If the pictorial system is selected by the student, then language development is experienced in the right-brain (Wonder & Donovan, 1984). Hopi Indian children show brain activity in the right hemisphere when speaking in their native language (Wonder &

Donovan, 1984). Anthropological linguist Benjamin Lee Whorf believes that this is because Hopis' view reality and themselves as part of the total environment (cited in Wonder & Donovan, 1984). This global philosophy is a right-brained perception.

Studies have been done to try to figure out which side of the brain dominates and why, but nothing conclusive has been shown. It seems that the hemisphere best equipped to deal with a stimulus will take over (Wonder & Donovan, 1984). For example, if a task is verbalized and a verbal response is expected, the left brain will take over. If the task is a visual relationship problem, the right brain will take over.

Education

Our modern day educational system has fallen prey to left-brain domination (Blakeslee, 1980; Hunter, 1976; Vitale, 1982). The tendency is to optimize memorization of well-defined verbal facts and ignore the more subtle and less easily tested effects of right-brain knowledge (Blakeslee, 1980). According to Blakeslee, Louis Terman, who developed the Stanford-Binet I.Q. test, believed that reasoning with verbal concepts was the highest expression of intelligence. In reflection of Einstein and his techniques for cognition, the Stanford-Binet I. Q. test would not have been valid. Einstein's verbal development was so slow that he probably would have scored quite low in his early years (Blakeslee, 1980).

Grades are also awarded in terms of verbal performance. Donald Taylor of Yale University studied correlations between engineers' grades in the last two years of college and employers' ratings of their originality (cited in Blakeslee, 1980). The results showed a correlation of only .26. A similar study of physicists gave a correlation of only .21. In another experiment, 267 college students were given a test to measure intuitive thinking ability. When the results were compared with the students' cumulative grade point averages, virtually no correlation (.048) was found.

These figures indicate that education ought to be as concerned with developing right hemispheres as it is with left. Education should employ techniques that reach visual, verbal, auditory and haptic learners (Vitale, 1982). Educators need to be aware of the differences in students and their learning styles. It should also be noted that in normal functioning people, the brain halves are in constant communication with each other. No one uses just one brain half or the other (Levy,1985). Educators need to work toward reaching all the brain and not just part of it.

CHAPTER III

Applications

Our society is in a state of transition from an industrial to an information dependent culture (Wonder & Donovan, 1984). Computers are rapidly taking over the linear types of thinking which were once confined to the human brain. Today's environment requires different skills than the past and flexibility is one of the keys. As educators, we need to constantly assess and restructure our teaching techniques, updating with the advent of new data. Split-brain theory has many implications in the area of education. Schools are guilty of directing most of their instruction through the left brain -- input consists of reading and listening, and output consists of talking and writing (Hunter, 1976). With a little knowledge of the human brain and some creative teaching techniques, perhaps we could reach a few more children.

Some simple strategies could be used by classroom teachers in order to reach both kinds of learners. In the course of a lecture, instructors could use chalkboards, pictures, charts, maps, artifacts or anything that could be viewed to help illustrate an idea. For example, if trying to explain the concept "battle" a teacher might say a battle is a large scale fight. The left-brained person would probably understand immediately, but a right-brained person would be fading in and out. If the teacher were to show a picture of a battle and an actual weapon used in battle while explaining the concept, both right and left-brain students would be drawn into the activity.

Another strategy would be to do hands-on experiencing. Encourage students to make charts, maps and graphs. Take students on field trips to actually see how concepts fit into the real world. Right-brained children have a difficult time dealing with the abstract, so the more realia contained in learning, the better. Invite speakers into the classroom to give students first hand information. Allow students to do some fantasizing and let them give plays or skits as summarizing activities. Theatrics and emotional expression are types of activities that involve right-brained students in an active role in the learning process.

One area of education that seems to have many possibilities for right brain development is values education. Currently, there seems to be a great deal of interest in this area. Teachers, counselors and people in substance abuse prevention could put together units that would help develop right-brain skills, while increasing self-awareness. Activities focusing on self-awareness and self-esteem have been shown to have beneficial effects in the prevention of substance abuse.

Teaching strategies which take into consideration the learning style of the student should also be considered. Instructors can incorporate the mode of consciousness preferred by the student through creating a setting and allowing students to formulate their own questions. Data can be collected using materials best suited for each individual's learning style. Similarly, information can be presented by a student in a manner meaningful to them. Evaluation can also be a custom-fit process, depending on the method of information summarization presented by each student.

In the age of the computer, it is very easy to gear most instruction to left -brained students. There are, however, many possibilities for reaching both the predominantly right-brained or left-brained student in the classroom. Teachers also need to remember that students learn with the "whole" brain and not just parts of it. Teachers need to be creative in their approach to teaching in order to reach all types of students. The challenge is there.

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