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ABSTRACT

Contemporary findings of brain research and language function can be analyzed and related to the teaching of creative and critical thinking and active learning through writing. A great deal of work has been carried out concerning the integration of the cerebral hemispheres for heuristic procedures in writing invention. In the integrated brain, the functions of one hemisphere are immediately available to the other, thus allowing a greater balance between the two brains during mental operations. Today, the notion of teaching to the whole brain is gaining more credence, being particularly significant to language arts educators since language production is a whole-brain activity. There are neurolinguistic implications for individual learning and language communication in both the writing lab and the composition classroom. These implications focus primarily on the concept of "active learning." Composition teachers can facilitate active learning by having students engage in the composing process frequently and by encouraging them to discuss their own writing freely with others. The degree of the brain's response depends on an active atmosphere in the classroom. Finally, a number of heuristics based on current research have been developed for writing teachers. The increasing knowledge of how the brain works suggests techniques useful to language arts teachers for the discovery of meaningful ideas and insights, and the effect of these writing strategies in a process-centered approach to composing and communicating strongly suggests that students are actively employing the operations of the whole brain to produce insightful and meaningful pieces of writing. (Thirty-three references are attached.) (HB)

Educational Implications of Brain Research Applied to Teaching Language Arts for Creative and Critical Thinking in Writing

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Abstract

This paper reviews brain research and language function, applied to teaching creative/critical thinking and active learning through writing. This discussion also reviews theory and research on integrating the cerebral hemispheres for heuristic procedures in writing invention. Neurolinguistic implications are given for individual learning and language communication in the writing lab and in the composition classroom.

In brain research, particularly on the cerebral hemispheres, investigators have speculated that the left hemisphere (LH) is dominant for language and logical/analytical thought in critical thinking, whereas the right hemisphere (RH) is specialized for intuitive/synthetic thought in cognitive processes dealing with holistic, spatial relationships and imagery, especially for creative thinking; in the integrated brain, however, the functions of one hemisphere are immediately available to the other, thus developing a greater balance between the two brains during mental operations (Routhier, 1979). What's more, Carl Sagan (1977) has also written:

> There is no way to tell whether patterns extracted by the right hemisphere are real or imagined without subjecting them to left hemisphere scrutiny. On the other hand, mere critical thinking, without creative and intuitive insights, without the search for new patterns, is sterile and doomed. To solve complex problems in changing circumstances requires the activity of both cerebral hemispheres. (pp. 190-191)

In education, the once commonly accepted notion of a major or dominant hemisphere must give way to a more whole-brain orientation; the notion of teaching to the whole brain is now gaining more credence among educators, for a holistic education helps students learn more efficiently (Yellin, 1983). This "holistic" notion is particularly significant to language arts education because the integration of both cerebral hemispheres permits linguistic-cognitive associations; that is, language production is a whole-brain activity for expressing ideas and feelings both orally and in writing (DeJarnette,1983).

Moreover, recent brain research strongly suggests that engagement in language communication, both in writing and in speaking, does integrate all brain functions to produce both critical and creative thinking for discovering or inventing insightful ideas from illumination. Consequently, student-centered language communication in the classroom is an integral part of a holistic education for using the entire brain to facilitate active thinking and learning through writing and speaking, especially important in the English class. Thus, the purpose of this presentation is to show the educational implications of brain research, specifically applied to teaching language arts in writing and speaking, and to offer strategies for discovery or invention of meaningful ideas and insights through the composing process and through communicating, which actively employ the operations of the entire brain.

Brain Function, Active Learning, and Writing

The educational implications of brain research particularly focus on the concept of "active learning" in school, which applies to the act of writing and strategies used for composing. For instance, learning and environmental adaptation influence the brain's structure and function, since the brain operates best when a person learns from and adapts to the environment by acting upon it. Learning is therefore an active process, and students must be encouraged to be active learners; only if students are actively engaged in learning--and not simply the passive recipients of the teacher's imparted information--will they be motivated maximally, and only active learning will develop their cognitive functions (Frostig and Maslow, 1979).

Moreover, skilled movements during active learning, such as in writing, require the concerted activity of both hemispheres, in which the LH is mainly responsible for verbalization while the RH is primarily responsible for visual-spatial features of letter-to-whole word formation, as well as word-to-whole sentence formation. Accordingly, this movement involving all brain functions, including the functions underlying emotions, should be included in any educational program because emotions in particular cannot be divorced from cognitive abilities or from attention and concentration. So, the classroom atmosphere must be warm, supportive, and positive, with each student's interests and concerns taken into account, in addition to the teacher helping students to integrate the processes of both cerebral hemispheres (Frostig and Maslow, 1979). Consequently, if a student moves from a dull, passive, and nonalert environment to a bright, active, and inquisitive atmosphere, that learner's I.Q. will accurately reflect his or her efficiency at tasks under a variety of conditions, since it is not true that I.Q. never changes (Kinberg, 1983).

In addition to these observations, language function itself is a complex, interactive, and multilevel activity of all brain systems, with each hemisphere involved in the cognitive operations of speaking, listening, reading, and spelling (also implying writing), all of which need verbal knowledge of the LH and visual-spatial abilities of the RH; so, skilled language performance in learning is associated with integrated rather than one-sided hemispheric functions. And since the brain is designed for action, learning is an active and constructive process rather than a passive

one, so the most efficient learners are active participants in the process, not passive absorbers (Kirk, 1983).

Since the cortical hemispheres overlap greatly in function, richly connected with each other by cerebral tissue, a "generative process of learning" results when the whole brain actively constructs meaning from environmental information, by using both verbal processing of the LH and image processing of the RH. According to scientific evidence of recent brain research, learning is basically a process of relating new information to previous experience from which a person actively creates or "generates" meanings or representations by constructing sentences, images, and inferences in order to store this information into long-term memory. Teaching, then, is largely the process of organizing and relating new information to the learners' previous experiences, thus stimulating the students to actively construct their own meanings and representations by what the teacher causes them to generate in a stimulating classroom environment (Wittrock, 1977,1981).

In light of these educational implications of brain function and learning, one meaningful challenge for students in the composition class is simply having them engage actively in the composing process frequently and discuss their own writing with others, thus activating this movement of skilled language performance which integrates all brain operations of both hemispheres. Students then become participants in active thinking and learning of the subject matter through their own writing processes. Such a complex, cognitive operation as composing is highly germane to the natural, neuropsychological operations of the entire brain network.

Moreover, engaging in writing further suggests that the whole brain is involved in actively constructing meaning through language when the student writer relates new information to his or her previous experience by creating or generating meaningful ideas, using such strategies as brainstorming, freewriting, writing the draft, and even revising. What's more, this process of creating meaning in composing is further augmented by writer/reader collaboration when the student and teacher hold conferences or when peers share their writing with one another, thus engaging two or more minds in thinking and learning by discussing the students' written texts. As for the notion of a "generative process of learning" (Wittrock, 1977, 1981), especially in learning through language, the brain's active construction of meaning can also be facilitated in writing by using "sentence combining," for it not only gives a writer a form, but also generates content or ideas from the sentence form itself (Hoyle, 1979). This learning process by composing also applies to Francis Christensen's (1967) methods of "a generative rhetoric of a sentence and a paragraph," which help student writers with the problem of invention and syntactic fluency by generating ideas and building sentences using free modifiers, and, in turn, generating paragraphs for whole discourse through cumulative sentences. Perhaps all of these writing techniques mentioned can be characterized as brain-compatible for active thinking and learning in language use.

Furthermore, the degree to which the brain responds to and acts upon what the student is experiencing in writing will depend on the atmosphere in the composition classroom. Since emotions do

play a central role in whole-brain function and cognitive abilities, the classroom environment should be warm, supportive, and positive so that the basic writers in class will adopt a more positive attitude towards writing by viewing it as an instrument for active thinking and learning, in addition to critical and creative thinking, and not as some mechanical, static, or even threatening exercise. Through conferencing, the teacher can provide this warmth and support, as well as discover what topics and ideas really interest or concern each student. Also, giving learners the freedom to write on these topics or ideas will motivate them to explore and discover new insights about the subject matter through composing, thus actively engaging the entire brain. Finally, since the structure and function of the brain respond best to novel experience in a stimulating environment, students should also be granted the freedom to write in various experiential settings, rather than simply the classroom, so that the brain can construct meaning more efficiently through composing, and relate this newly discovered, novel information to the students' previous experiences. In sum, these considerations for the composition class help to promote active involvement in both critical and creative thinking for writing invention.

Hemispheric Integration and Heuristics for Writing Invention

Both critical and creative thinking involve integration of the cerebral hemispheres, essential for rhetorical invention and problem-solving in writing. Hemispheric integration of the brain is especially important for creative thinking so that incubation and illumination can occur in the mind, from which new ideas or insights are discovered or solutions are found to problems (Stroh,1982).

Incubation and illumination of ideas are particularly significant to the very nature of writing because these phases of creative thinking also occur during the stages of the composing process, and composition teachers should give students ample time to let these thought processes develop for discovery of new and meaningful ideas so that basic writers can produce a solid and insightful piece of prose.

Interestingly, within these stages of creative thinking, it is believed that the picture-like imagery of the RH serves as a vehicle through which incubation produces illumination, insight, and creativity. Emanating from the intuitive sources of the RH, these images are not passive, but have an active generating and heuristic effect, leading to creative discovery of ideas. And once this imagery produces insight, then there is intense LH activity to think critically about verbalizing, describing, and changing this imagery into an "intellectually negotiable form" so that these newly discovered ideas can be communicated and articulated effectively to others (Gowan, 1979).

What's more, although the LH does recognize and reformulate RH images into language, the LH only works with information already known and stored in the brain (Gardner, 1978) and is unable to generate new ideas or create meaning out of them. It is from the RH that new ideas, total contexts, and the creation of meaning emerge, without which there would be no ideas. However, without the LH these ideas would not be encoded, understood, or communicated. In light of these speculations about the brain's functions, a strategy for tapping the powers of the RH involves "learning by doing" tasks in an enriched, experiential environment,

thus providing the RH with the stimulus to activate and bridge whole-brain function, in addition to strengthening brain neurons for increased thinking and learning capacity (Hatcher, 1983). Accordingly, this enriched, experiential environment of "learning-by-doing" clearly applies to engaging actively in the writing process, not only to stimulate the sources of imagery and ideas of the RH, but also to verbalize and communicate these image-produced insights through the operations of the LH, thus activating the powers of the entire brain. And to facilitate this creative discovery of ideas from illumination, "freewriting" is one such heuristic technique for invention because this free flow of thoughts from intuition to the writer's paper stimulates natural fluency, insight, and creativity in active thinking (Winterowd, 1977; Mandel, 1980).

Moreover, in a discussion of "current brain research and the composing process," from an article in the journal CEA Critic, Monica Weis (1982) suggests that RH activity is a significant component of writing, further recognizing the need to encourage the creative and intuitive part of composing. And she calls for researchers to develop functional heuristic procedures to help students get insightful ideas down on paper, not only involving logical-analytical ordering of the LH, but also engaging the intuitive-synthetic patterning process of the RH, an interplay of both hemispheres which can be taught as well as learned. In fact, Weis says that when the mind is free from logical thought and analytic judgement, as in argumentative essays, then the RH produces holistic perception, flashes of insight, and new discoveries through writing. What's more, with guidance in heuristic procedures which

strengthen RH activity, Weis claims that students select and arrange data from their own experiences, reaching insight at some moment when they discover what they really want to write about for describing an experience to an audience; that is, students gain insight into how language shapes and gives meaning to experience. However, she does advise that such heuristic procedures as brainstorming, freewriting, and problem-solving must be more than a memory-retrieval aide, allowing sufficient time and respect for students' recursive, cyclical stages of rhetorical invention of ideas in their composing processes. So, she suggests Peter Elbow (1973) and Kenneth Macrorie's (1970, 1976) approaches of freeing students to discover ideas and to write sufficiently. In short, basic writers can shape and give meaning to their own world, through composing, according to their own intuitive patterning. Finally, Weis also suggests the holistic effect of music or visual stimuli in the composition classroom, both of which are directed stimuli to creative thinking.

As for composing to music, interaction between the two cerebral hemispheres can be beneficial, especially from such integrated bihemispheric activities as symphonic orchestration (Bogen, 1977). With this notion in mind, it is interesting to note that in an informal study using symphonic music with freewriting in my basic composition classes, I discovered that many of my students reported writing about images they were creating from listening to the music during these fifteen-minute composing exercises. What's more, upon examining these pieces of freewriting, I also found that many of my students automatically wrote short stories in a coherently unified and

creatively composed narrative form, without these basic writers having any prior, formal instruction or conceptual knowledge of a narrative's structure. These findings suggest that students already intuitively know about coherent, part-whole relationships in writing discourse, especially in the narrative form, and that the holistic effect of this music integrates the auditory, visual, and verbal processes of both hemispheres for whole-brain action during composing. Writing to this music not only serves as a heuristic method for creative discovery of ideas, but also serves as an inductive way to get students to understand the notions of cohesion and coherence in writing, in addition to emphasizing that students must <u>show</u> the reader through the visual-verbal quality of their writing, instead of simply telling the audience.

In regard to using visual stimuli for composing, researchers report in a number of studies that self-generated imagery and verbal representations of information facilitated learning, which suggest drawing on the RH to develop language skills by using imagery to increase vocabulary and syntactic skills--for instance, having learners describe pictures with words and sentences, further reinforcing the notion of showing the reader, and not simply telling, through a piece of writing (Wittrock, 1977, 1980).

Also combining the visual and the verbal processes of both cerebral hemispheres are such heuristic methods as "clustering" (Rico and Claggett, 1980) and "mapping" (Buckley and Boyle, 1981), both of which serve as a "generative, visual" technique which uses the image mode of the RH to produce a graphic map or representation of a written composition containing key words and phrases. These strategies help students discover, generate, and synthesize or associate part-whole relationships among the images and ideas they

are producing, in addition to aiding basic writers in organiz. these ideas in their texts through the words and phrases. Consequently, teachers will begin to observe their students moving from the inability to generate ideas into words and toward the facility of producing a great deal of writing.

In sum, all of these heuristic strategies mentioned so far can also be characterized as compatible to the neuropsychological actions of the entire brain network involved in active thinking and learning during the process of composing, because these methods of invention in writing help to integrate the image-illuminating sources of the RH with the verbal powers of the LH so that the whole brain actively constructs meaning through generating and communicating insightful ideas, engaging both creative and critical thinking while composing.

Neurolinguistic Implications for Individual Learning and Language Communication in the Writing Classroom

Brain research also indicates that teachers should take into account individual learning styles and language communication, especially in the composition classroom. First, the integration of the cerebral hemispheres should be developed in students by individualized instruction and approaches to learning because of the many different modes of thinking in brain processing; students cannot fully enjoy the right to learn until they are offered learning conditions that take into consideration their individuality (Claycomb, 1978). What's more, brain discoveries may encourage educators to move away from the traditional "group/normative" approach to students towards the more "individual/diagnostic" educational plan (Sywester, 1981). In teaching writing, this

individual instruction in class can be undertaken by using teacher/student conferencing on a one-to-one basis in a writing lab situation. In conferencing, individual diagnosis of strengths or weaknesses in writing and a plan of teaching can be tailored to the student's needs and personal thinking and learning styles, in addition to creating a balanced interaction between the student and the teacher and opening up communication.

Moreover, language communication is the significant brain-related issue here, in that it is just as important for students to talk in the classroom as it is for them to write. Again, psycholinguistics and the neurosciences indicate that the brain is constantly active, but the teacher turns out to be active and the students remain passive by simply listening. So, students must actively talk to learn best; a "stop talking" class is likely to be a "stop learning" environment. The reason for talking is that a significant portion of the brain is structured towards oral language, as well as writing and reading, and that thinking aloud is necessary to expand brain capacity; consequently, since a great portion of the brain is devoted to language, students must talk to learn as well (Hart, 1975, 1978, 1979).

To promote full-brain activity in creative and critical thinking, classroom and writing lab conferences should be student-centered talk, not simply teacher-directed speaking. Students must have the opportunity to talk freely about their own ideas and language in the written text, while the teacher listens as well as asks questions so that the students can respond orally to their own writing, in addition to actively thinking about and clarifying the ideas they have generated onto the paper. Conferencing can also be an effective heuristic method for discovery of ideas.

What's more, communication can also be heightened by using peer groups to discuss students' writing. For example, building writing skills can be facilitated by first using a visual base in which students carefully examine a picture and write a paragraph describing what they see; then students are encouraged to talk in peer groups by asking and answering questions on the "who, what, when, where, how, and why" of their writing experiences. This activity in composing and talking helps to build understanding and creates situations for expressive language, thus integrating the LH's verbal-analytic functions and the RH's visual-synthetic processes to facilitate inductive and deductive reasoning, critical thinking, and decision-making (Webb, 1983), as well as creative thinking.

In addition, by having group discussion in which students exchange reactions and observations of natural responses to a word picture, the basic writer can share his or her experience with the listener or reader and, at the same time, get feedback on the piece of writing. The rational behind this heuristic activity is that the main language of the RH is composed of sensory images or impressions, and that the main way to develop conscious, verbal-brain awareness is to describe something, not only in writing, but also orally to a listener, even while the speaker/writer is actually observing it, thus discovering more about the experience and joining the powers of both hemispheres. In fact, verbalizing some rich or novel experience while observing it develops the LH and sophisticates a person's command of the language by using visual thinking of the RH, considered the most rewarding and effective mode of thinking known (Wenger, 1981).

In summary, student-centered speaking as well as composing can engage the whole brain by integrating the visual and verbal processes of both hemispheres, particularly when basic writers talk about their own descriptive writing for discovery of ideas in rhetorical invention. And to facilitate whole-brain functions for generating insightful ideas and for creating meaning, peer-group discussions and individualized teacher/student conferencing not only increase communication in the classroom but also promote active and collaborative thinking and learning in composition.

Conclusion

In closing, brain research does suggest that language communication in composing and speaking has an integral part in a "holistic education" for integrating both cerebral hemispheres. What's more, these modes of communication, along with the proposed heuristic strategies for writing invention, play a central role in the "new paradigm" of teaching composition, shifting from the traditional, teacher-directed mode of instruction to a more student-centered, brain-compatible mode of active thinking and learning. Finally, in a process-centered approach to composing and communicating, the effect of these writing strategies strongly suggests that students are using the operations of the whole brain, for both creative and critical thinking, to produce an insightful and meaningful piece of writing.

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