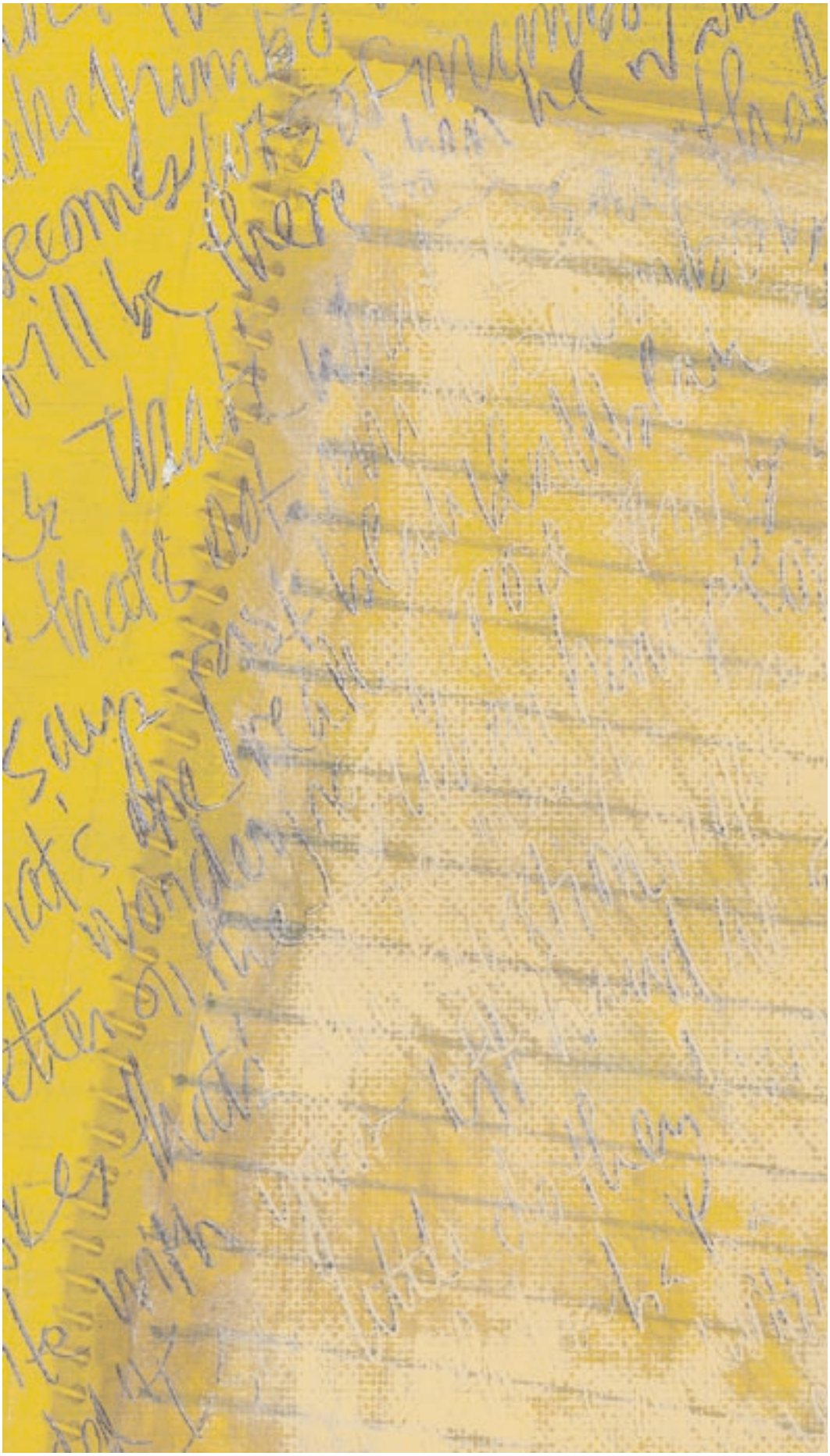


Historical Perspective

Historical Perspective: Major Theories Modeled in The 4MAT System for Teaching Learning and Leadership

Clif St. Germain

Bernice McCarthy's 4MAT® System is a teaching model which combines the fundamental principles of several long-standing theories of personal development with current research on human brain function and learning. This working paper briefly summarizes these theories and research studies and describes the nature of their contribution to McCarthy's model for teaching. Readers are invited to select, according to interest, among the independent sections of this paper.

Section One summarizes prominent theories of personal development which have greatly influenced the ideology and validation of The 4MAT Model. The fundamental assumption of The 4MAT Model, **that humans learn and develop through continuous, personal adaptations as they construct meaning in their lives,** is derived from the work of John Dewey, Carl Jung and David Kolb. Included in this section are references to basic assumptions modeled for Dewey and brief descriptions of Kolb's Experiential Learning Theory, and Jung's Theory of Individuation.

Section Two traces the historical evolution of the concept of cerebral asymmetry and references studies which have particular applications for teaching-learning situations. Specifically addressed are results of recent studies as to the nature of hemispheric specificity and its significance as an aspect of human individuality and personal development. Also included in this section are findings which document relationships between cognitive style, gender, and handedness, and hemispheric specificity. These studies provide considerable support for Bernice McCarthy's inclusion of hemispheric specificity, a factor influencing teaching and learning environments.

The final section of this paper, Section Three, is written specifically for practitioners and consultants. It contains summary descriptions of the eight steps of Bernice McCarthy's 4MAT Model. Also Included in these descriptions of The 4MAT Model are explanations of those concepts which, each in their own way, reinforce the seminal message of 4MAT... ***"that the essential connectedness of knowledge and experience can never be omitted without consequence to the development and individuality of the learner."***

Special note: Bibliographic notations have been omitted to facilitate ease of reading. A bibliography of suggested readings is provided in section 7.

Section One: The Centrality of Experience and Individuality in Learning

The Pedagogy of Instrumentalism

John Dewey

At the turn of the twentieth century, the bulk of accepted research on human cognition and learning focused upon discovering general laws of human knowing or principles of intelligence. Various investigations of mental ability generated statistical methods for ranking human beings in terms of their intelligence. At this time, most theorists supported the view that intelligence was biologically determined and was virtually synonymous with specific forms of abstract thinking. Implicit in this "locked in" view of intelligence was the assumption that this intelligence trait, once identified, set the parameters for, and in fact predicted, an individual's potential. Thus schools, especially institutions of higher learning, were promulgated to identify and train promising students in the rigors of abstract conceptual thought.

However, concurrent with the advent of the scientific revolution many theorists and researchers began to challenge as incomplete this view of human intelligence and learning. Scientific inquiry prompted a change in man's view of himself and the nature of his intellect. Concurrent with the advent of this scientific revolution was a shift away from the sole emphasis upon the acquisition of abstract ideas, to the scientific verification of ideas in actual experience. This shift, although traceable through several stages of development, can be attributed in large measure to John Dewey and forms the basis of his efforts to reform the American education system. For Dewey, schools were testing grounds for thought. He added creating and testing ideas in experience to the role of the school.

In 1916 Dewey wrote *Experience and Education,* in which he asserted that all learning required the transactional interaction between the individual and the environment. Dewey's biology-based theory made a case for learning by doing instead of learning by abstraction or rote. Thus he preferred the word *"instrumentalism"* as a description of his philosophy of education which emphasized the testing of the practical consequences of ideas. For Dewey, experience, the interaction of the individual with the environment as a testing ground for ideas, is paramount.

In 1933 Dewey published *How We Think* . This book described his five-step method for thinking which involved: (1) reflecting upon a problem, (2) establishing the limits or characteristics of the problem in precise terms, (3) testing possible solutions and postulating a wide range of hypotheses, (4) considering possible outcomes and acting on these considerations, and (5) acceptance or rejection of the solutions. Dewey's stages of thinking were designed to systematize a "method" for working through each human experience as it arose. His work in the Laboratory School at the University of Chicago documents this system as a pedagogy and demonstrates its applications for testing ideas in the context of real-life experiences.

It should be noted here that John Dewey's philosophy of education emphasized the importance of human experience as a gateway to human understanding. To this end, Dewey wrote extensively about the interconnectedness of scientific, social, esthetic and moral aspects of education. His writings clearly reflect his belief in the "consummatory educational experience," one in which both the individual and the environment are in harmony. History credits John Dewey with the introduction of a pedagogy which unites the mind and the body of the learner through a method of thinking and doing, an experience he called the supreme art form… the art of education.

John Dewey, is a significant contributor to the the 4MAT System. His dictum that developmental education required the provision of experiences which inform the learner of the limits and con-

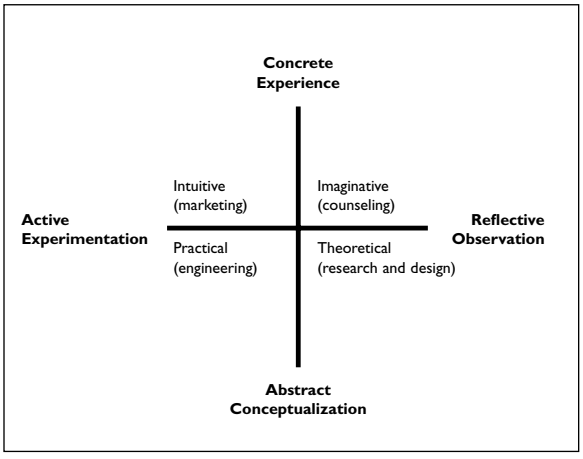
tradictions of his/her way of constructing the world is modeled throughout the eight steps of The 4MAT System. Also modeled as a guiding principle of 4MAT is the role of the teacher as one who fosters over a shorter period of time that development which would be natural over the course of an individual's lifetime. These principles and their application to teaching/learning situations are described in some detail in section three of this paper.

Today, researchers are confirming the significance of personal experience in the deployment of brain function and cognitive abilities. Using recently developed brain scan technology it is now possible to document that the human brain, although "hard-wired" to function in specific ways, is also incredibly flexible in the deployment of these functions. As a result of these studies, there is growing evidence that each human being perfects a specific set of cognitive operations (and not others) as a result of personal adaptations to his/her life experiences.These cognitive operations, often referred to in the literature as intellectual potentials, result in high levels of competence in diverse areas of human endeavor. Additionally, there is also support that the human brain continues to adapt and expand for the lifetime of the individual. From this broader perspective, *that cognitive potential is not hidden in the mind awaiting perfection; rather, it evolves and diversifies through use*, it is clearly supportable that John Dewey's insights about the importance of experience in learning were accurate.

Experiential Learning Theory: A Lifelong Cycle of Learning and Development

David Kolb

Another widely researched, experience-based theory of human learning and personal development is David Kolb's Experiential Learning Theory. Also based on an expanded view of human intellectual capacity which involves testing ideas in actual experience, Experiential Learning Theory focuses on those adaptive modes of thinking from which productive lines of thought and action can be fashioned. According to Kolb human learning and personal development are synonymous processes which involve the continuous integration of a distinct set of independent systems that give meaning to life's circumstances. Kolb specifically names these systems (or modes) as follows: Concrete Experiential (CE) , Reflective Observation (RO), Abstract Conceptual (AC), and Active Experimentation (AE).



At the heart of Kolb's theory is the conviction that learning is a continually recurring process

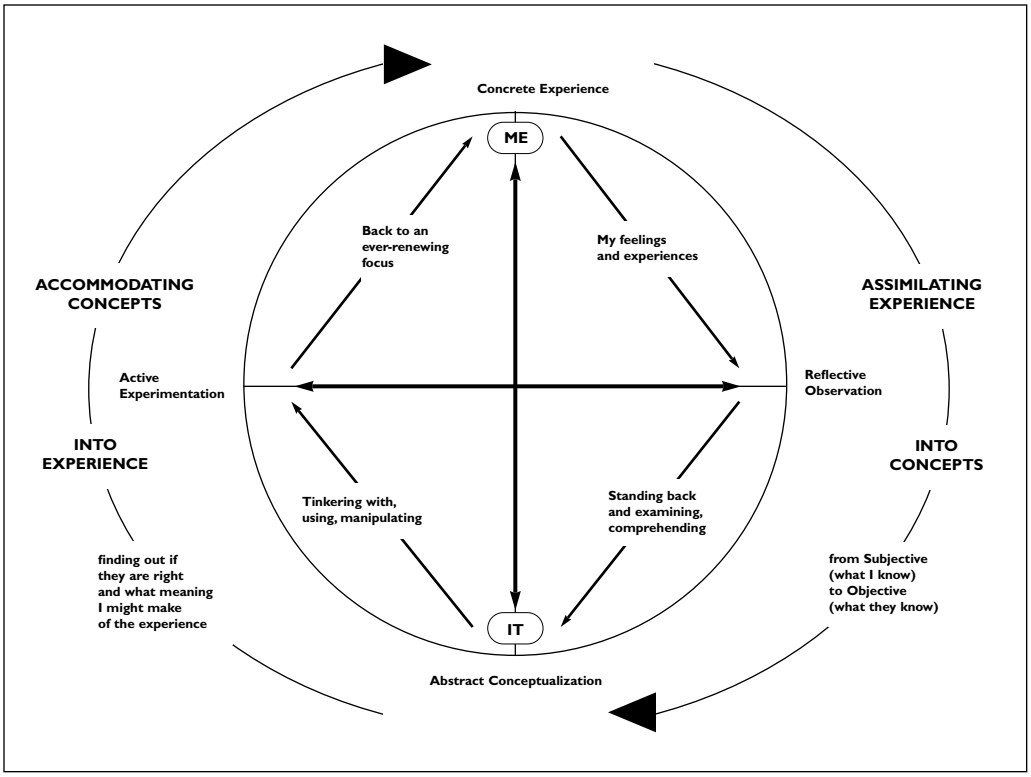
through which individuals refine and integrate basic adaptive modes for perceiving, thinking, acting and feeling. The major assumptions of the Kolb Model include the following: (1) learning is a continual process, not an outcome, (2) learning is grounded in personal experience, (3) learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world, and (4) learning involves transactions between the individual and the environment whereby experiences are transformed into knowledge and actions. For Kolb, learning is the constant, all encompassing central life task, and how one learns becomes a major determinant of personal development.

According to Kolb, Experiential Learning Theory is a holistic concept that objectifies the resolution of tensions between basic modes of personal adaptation. Kolb's theory is, therefore grounded in the idea that individuals attain higher levels of cognitive complexity through the integration of preferred and less preferred modes of adapting their personal circumstances.

Cycle of Learning

David Kolb's Cycle of Learning is the theoretical basis for the 4MAT Model. According to Kolb, adaptations to the environment proceed through a naturally recurring dialectic which begins with a valuation of the learner's prior experience. This valuation, (usually an affective judgment), creates the context for engaging perception through observation and reflection. These observations enable the learner to move to a second stage in the process which is oppositional to affect and personal experience, a stage which requires a shift away from affect toward conceptual abstraction and the construction of a validated theory. From the construction and assimilation of this theory, the learner proceeds to the testing or third stage of the cycle in which implications for behavior are determined. The testing phase is oppositional to perception and reflective observation. The cycle completes itself with the integration of these implications into a newly constructed synthesis which forms a composite for action.

Thus Kolb's Experiential Learning Model describes a process through which the four modes of human experience are engaged at various levels of complexity to create more complete levels of understanding. For Kolb, the adaptive engagement between and among the modes of concrete experience (CE), reflective observation (RO), abstract conceptualization (AC) and active experimentation (AE) is prerequisite to learning and personal development . For example, one might view a problem exclusively from the perspective of personal experiences with this problem or those problems considered to be similar, or one might view a problem from what has been verified by experts about the nature of the problem. The decision to trust one adaptive strategy over the other is personal. One might also attempt to resolve the problem by reflecting upon it and designing a plan, or by manipulating and testing applications until a solution can be found. Balance and experience with all four of these adaptive learning modes is the basis of Kolb's theory. Simply stated, according to Kolb, "individuals expand their learning and adaptive processes through exercising them."



Additionally, according to Kolb, when contrasting world views are consistently resolved through the suppression of one mode and the reliance upon its opposite, learning tends to become automatized around the trusted mode and limited in those areas which are suppressed. The result is a preferred "style" for learning. Kolb asserts, " over time, accentuation forces operate on individuals in such a way that the dialectic tensions between these dimensions are consistently resolved in a characteristic fashion. Some people develop minds that excel at assimilating disparate facts into coherent theories, yet these same people are incapable of, or uninterested in, deducing hypotheses from the theory. Others are logical geniuses but find it impossible to involve and surrender themselves to an experience... Each of us in a unique way develops a learning style that has some weak and strong points."

Kolb has also popularized a classification system which identifies four basic learning "styles" which are described as follows:

- Divergers (CE+ RO) rely upon their concrete experiences and process these experiences reflectively;
- Assimilators (AC+RO) rely upon theories and abstract conceptualizations which they process reflectively;
- Convergers (AC+AE) rely upon abstract conceptualizations of the world, and process these them actively;
- Accommodators (CE+AE) rely upon their concrete experiences and process them actively.

Using these four learning styles Kolb articulated his concept of *environmental learning press,* the idea that differentiated complexity inherent in each environment facilitates a particular type of adaptation. According to Kolb, a situation that demands experimenting with behavioral alternatives enhances and reinforces active experimentation. Hence, for Kolb, a particular task or

environment may be particularly fertile for enhancing one or another generic adaptive competence. Kolb reports that his examination of these four styles of learners in careers reveals that Divergers are over-represented in social professions, Assimilators in science-based professions, Convergers in natural science/ mathematics careers and Accommodators in humanities and social science. Again, one expands his/her learning and adaptive processes through exercising them, according to Kolb:

> "Divergers are apt to turn aside the challenge and tedium of abstract analysis in favor of pursuing new excitements, or to resist and delay making the decisions required for taking action when it is called for. Convergers, on the other hand, are apt to ignore or stereotype others in favor of applying abstract principles to problem solving. The former often defends against symbolic and behavioral complexity, while the later defends against the affective and perceptual. Accommodators and Assimilators likewise have their ways of reducing and defending against kinds of complexity with which they are ill-equipped to deal."

Principles of 4MAT modeled in Kolb

David Kolb's Experiential Learning Theory, specifically his cycle of interaction between Concrete Experiential (CE), Reflective Observation (RO), Abstract Conceptualization (AC) and Active Experimentation (AE) modes of personal adaptation, *is the theoretical basis for The 4MAT System for Teaching, Learning, and Leadership*. McCarthy credits Kolb for the structure upon which she built her model. And while McCarthy has slightly changed the articulation of Kolb's theory to incorporate other theories and to reflect more recent research, each change was an extension of rather than departure from, Kolb's original dictum that individuals expand their adaptive processes through exercising them.

Theoretical models which categorize individuals as one type or another are appealing to some and are odious oversimplifications to others. Nevertheless, different classification systems have been fruitful as general descriptions of human behavior. Most psychologists use the term "personality" to describe the full complex of reactions which distinguish an individual from others. Personality is distinguished from "type" in that type deals with individual reactions (or predisposition) to specific events. In this way, cognitive or learning type classifications like McCarthy's Learning Type Measure and Kolb's Learning Style Inventory are, by design, limited to learning.

It is noteworthy here that the functions and descriptions of the four adaptive modes described in Kolb's Experiential Learning Theory have survived the test of twenty years of implementation. Applying Kolb's theory, McCarthy demonstrates that her model effectively orchestrates a repertoire of specific teaching/ learning sets which balance tensions between concrete experiential and abstract conceptual orientations. The comprehensive quality and depth of these learning sets, especially their articulation in practical language, are McCarthy's contribution to the expansion of Kolb's theory. McCarthy's model also provides for balance between reflective observation and active experimentation through specified variations in teacher/learner interactions. Learning by validating preferred modes of adaptation while stretching to less preferred modes are clearly unifying principles in both Kolb's and McCarthy's models.

There is a difference between Kolb's theory and McCarthy's Model in the way learning style is classified. For Kolb, individuals are classified into one of four learning styles based on a mathematical computation which derives from the individual's score on a self-report instrument which measures preferences for perception and processing. This style is then described in terms of individual behaviors. McCarthy emphasizes the independent yet related nature of all four of

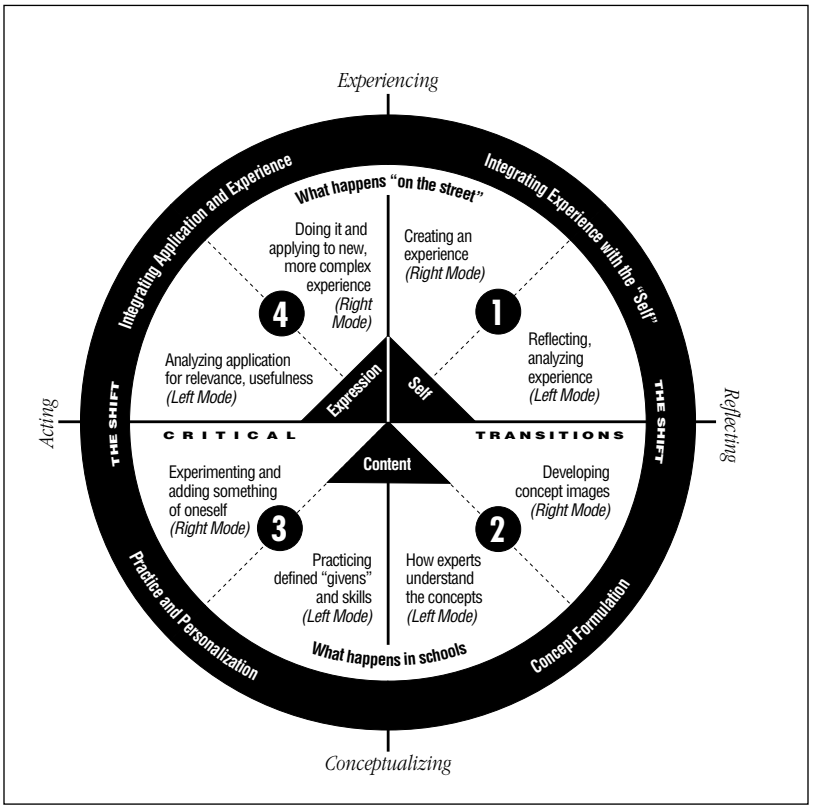
Kolb's aspect of style. She describes a leading adaptive mode, two supporting modes and a least preferred mode. Using her 4MAT Model, McCarthy draws attention to the commonalities in learning that individuals share, while also indicating the extent to which the behaviors of others must be accommodated.

In this way McCarthy applies Kolb's constructs to helps individuals compare their composite profile to the specific task requisites in any endeavor (Kolb's Environmental Press) and then make decisions about employing their preferred modes while managing or stretching less preferred modes.

Therefore, McCarthy resists the temptation to classify learners in terms of a single style. In McCarthy's Model, the key issues are the level of differentiation (or preference) and juxtaposition of each of Kolb's four contrasting ways of understanding and acting on life's circumstances.

Also, for McCarthy, each of the four preferences is considered separately in light of its degree of reliance upon reflective or active processing. In essence, McCarthy is saying that individual learning style is the degree to which individuals differentiate and use each of Kolb's four ways of knowing. Style for McCarthy, is the relationship between and among these modes as much as it is the most preferred.

Additionally, when Kolb popularized his Experiential Learning Theory little was known about the influences of hemispheric specificity upon teaching, learning and human development. The inclusion of hemispheric specificity as a further determinant of individual differences in learning is a further extension of Kolb's model by McCarthy. McCarthy, has overlaid a right and left hemispheric variation within each of Kolb's four styles. Again, these additions were not a departure from but a deepening of Kolb's model.



In light of the adaptations of Kolb's model by Bernice McCarthy it is reasonable examine the measurable commonalties which continue to exist between the two models. In recent years, statistical relationships between Kolb' constructs of CE, RO, AC and (AE) [as measured by his Learning Style Inventory] and the four adapting modes which McCarthy has named quadrant one through four respectively [as measured by McCarthy's Learning Type Measure] have been established and are reported as follows:

Concrete Experiential (CE) is significantly related to Quadrants 1 and 4 as measured by McCarthy's Learning Type Measure (LTM).

Abstract Conceptual (AC) has the highest mean score in Quadrants 2 and 3; however the means were not statistically different from each other

There is a statistically significant difference between LTM quadrant scores on Reflective Observation (RO) comparisons with Quadrant 2 having the highest RO mean score and Quadrant 1 having the next highest mean

There is a statistically significant difference between LTM quadrant scores of Active Experimentation (AE), with Quadrant 4 having the highest AE mean score and with Quadrant 3 having the next highest mean.

From these data it is reasonable to report that
CE is related to Quadrants 1 and 4 (or 12 o'clock in McCarthy's model),
RO is related to Quadrants 1 and 2, (or 3 o'clock in McCarthy's model),
AE is related to Quadrants 3 and 4, (or 9 o'clock in McCarthy's model),
AC is related to Quadrants 2 and 3 (or 6 o'clock in McCarthy's model).

Both Kolb's Experiential Learning Theory and McCarthy's 4MAT Model support the following conclusions:

- individuals learn in different yet identifiable ways;
- differences in learning style, although clearly not related to aptitude, are significantly related to personal motivation and performance;
- learning is a continuous, cyclical, lifelong process of differentiating and integrating personal modes of adaptation; and
- learners expand and refine adaptive modes by exercising them.

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Individuation:
A Theory for Growth and Personal Development

Carl Gustav Jung

Jung's Theory of Personality Types, like Kolb's Experiential Learning Theory is a holistic theory of human development which assumes the presence of measurable and consistent individual preferences for making sense of the world. Jung postulates that. . . much apparent random variation in human behavior is actually orderly and consistent, being due to certain basic differences in the ways people prefer to use modes of perception and judgment.

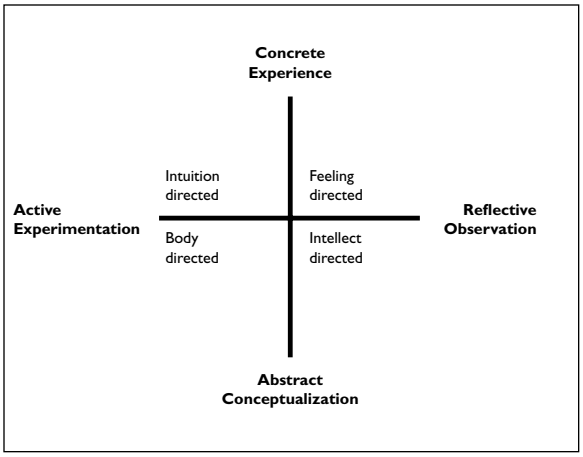
For classification of the limitless variations in individual behavior Jung relies upon what he calls the four basic functions: sensing, thinking, feeling and intuition. These functions are opposing modes for making sense of the world. According to Jung, sensing refers to taking in the observable by way of the senses, which tells you something exists; thinking, a term used to define logical decision-making processes, tells you what something is; feeling, a term for the process of appreciation in terms of subjective/personal value, tells you whether something is of value or not; and intuition, a term used for apprehension of meanings, relationships and possibilities by way of insight, tells you when something connects, where it came from and where it is going.

Jung also emphasized that individuals continued to differentiate their personal type (a term Jung used for preferred functions) throughout their lives. According to Jung, a mature individual is one who has developed command of all four functions, elevating two of the four functions to a dominant and auxiliary status and differentiating the use of and respect for the remaining less preferred functions. This process, called *Individuation,* is a cornerstone of Jung's work. Jung defines individuation as a process of differentiation, having for its goal the development of the individual personality."

Jung used the terms extroversion and introversion to describe two basic attitudes toward the environment. Extrovert are individuals who focus attention on objects and people in the environment ,while introverts focus on the consolidation of energy within themselves. Kolb named these attitudes Active Experimentation and Reflective Observation.

A third dichotomy, the judgment-perception preference, added later to Jung's theory by Isabel Myers, discriminates an individual's predisposition for imposing order upon the environment. According to Myers, judging types impose convergent, orderly systems upon their environments. Perceptive types, by contrast, impose personally ordered, divergent systems upon their environment.

Jung's contribution to 4MAT (and subsequently to teaching/learning environments) was his precise descriptions and research on Psychological Types and their preferences in personal development. These descriptions of type were later formalized by Isabel Myers and researched extensively. Isabel Myers, who through development of a standardized instrument for identifying Jungian type preferences (The Myers-Briggs Type Indicator) used Jung's Psychological Types to help teachers understand their students. A compendium of research findings on Jungian Type as measured by the Myers-Briggs Indicator is available through The Center for the Applications of Psychological Type (CAPT) , Gainesville, Florida.



Principles of 4MAT modeled from Jung

Jung's Theory of Psychological Type, specifically his concepts of *Individuation,* and *differentiated functions* are modeled throughout The 4MAT System for Teaching, Learning, and Leadership. For example, in 4MAT, learning type is described as the order and juxtaposition of four possible type preferences. These preferences are then reported relationally from most preferred to least preferred. In this way individuals report their preferences for dominant (most preferred), support or auxiliary (second most preferred), third and least preferred. The message here, modeled from Jung is that continued personal development requires the differentiation of less preferred functions and the balance of the individual's type. If Kolb's cycle represents the outer structure of the 4MAT Model, Jung's theory adds text and additional form inside the cycle.

Also, statistically significant relationships have been established between 4MAT learning types as measured by the Learning Type Measure (LTM) and the functions and attitudes of Jungian typology such as Feeling, Sensing, Thinking, Intuition, Extroversion and Introversion. For example, McCarthy's Type One Learner has been statistically correlated with Jungian "Feeling types," Type Two with "Thinking types," Type Three with "Sensing types," and Type Four with "Intuitive types." There is also a significant correlation between the Watching score on the LTM and Introversion and between the Doing score and Extroversion. Types One and Four also report highest means on Perception and Types Two and Three highest means on Judgment as measured by the Myers-Briggs Type Indicator (MBTI).

It should be noted here that while correlation between the individual functions of Jungian typology and 4MAT learning types are supportable, one to one correspondence between the four aspects of Jungian Type (as measured by the MBTI) would oversimplify these constructs and therefore are not to be expected. Jung's theory deals with the wholeness of personality, a constellation of human behaviors, while 4MAT focuses primarily on those behaviors related to the learning process. However, because the requirement to resolve the tension of polar opposites (central to Jung's process of Individuation as well as Kolb's Experiential Learning Model) forms the basis of the rationale for the 4MAT Model, it is reasonable to expect that those constructs drawn from Jungian theory would be related to similar constructs in the 4MAT Model.

Section Two:
Hemisphericity and Human Learning

Introduction

Four centuries ago, Rene Descartes made a prophetic discovery. He discovered that the brain had a dual organizational structure. He also observed that one small gland, the pineal, was the only aspect of the brain's structure that was not duplicated. From these observations, Descartes proclaimed that the pineal gland was the seat of human consciousness. He based his conclusion on the assumption that the nature of consciousness was unified; therefore, the pineal was the logical choice for the biological storehouse of human consciousness.

After 400 years of investigation, there is still disagreement as to the nature (not to mention physical location) of human consciousness. However, owing to biological observations of scientists from Rene Descartes to Roger Sperry, and to recent advances in technology, the once mysterious relationship between the biological organization of the brain and human learning is, for the first time in history, "researchable."

Today, clinical studies with "split-brain" patients (patients whose two hemispheres have been disconnected for medical reasons), and brain research on normal adults and children using specially developed technologies like Magnetic Resonance Imaging (MRI), Electroencephalogram Scans(EEG), Dichotic Listening Tests and Blood Flow Maps confirm the following:

(1) that the hemispheres of the human brain process information and experience in identifiably different ways;
(2) that the neural organization in each hemisphere is complementary yet different;
(3) that the corpus callosum, the bundle of nerve fibers connecting the two hemispheres of the brain, serves to integrate the actions of the hemispheres;
(4) that hemispheric specificity and hemispheric disposition (use preference) are quantifiable; and
(5) that individual preferences for hemispheric integration have clear relationships to cognitive style, especially with regard to learning.

By identifying the specific ways in which the human brain deals with different kinds of information and experience, researchers are uncovering the biological roots of human learning. *Scientific interest in hemispheric specialization, especially attention to the integration of the cerebral hemispheres, (nature's plan for maximizing human potential and intelligence) clearly adds "biological validation" to what once was pure conjecture about how individual differences occur in humans.* Additionally, brain studies have influenced the world view of what it means to "be smart". These findings create the context for a new more complete way of knowing ourselves which is finding its way into workplace systems and even schools. Many of these studies also document striking gender differences in the biology of the male and female brain as well as differences in the ways the sexes orchestrate hemispheric integration.

It is particularly noteworthy that, however promising, much of the research elucidating the biological nature of hemispheric specialization has also been widely criticized as speculative and inconclusive. Much of the criticism is no more than semantic bickering over existing concepts and terms, or disputes about locating intellectual functions in specific areas of the brain. For example, Ralph Strauch, author of *The Reality Illusion,* cautions that the problem with the left/right cerebral model is that, in terms of the metaphor, it is a left-brain description of the workings of the brain. That is to say, it divides the mind into neat, logical categories and encour-

ages us to believe we understand the working of the brain in analytic terms alone, without using the deeper and softer modes of understanding also available to us.

The real issues that warrant clarification and analysis are those related to the implications and practical applications of this data. The intention here is not to explain the workings of cerebral asymmetry. The goal is to present the facts in an effort to "demystify" one of the most significant discoveries of our time: the biological roots of human individuality.

Development of Cerebral Asymmetry

There is still little understanding of the reason the human brain developed hemispheric specialization in the first place. Two theories as to how our brain organization evolved are prominent in the literature.

Doreen Kimura and her colleagues have proposed that hemispheric specialization, especially left hemisphere dominance for language, emerged more as a result of the evolution of certain motor skills " that lend themselves to communication" than as a consequence of the asymmetric evolution of symbolic functions.

Therefore, the left-hemisphere evolved language, not because it was more analytic per se, but because it became well adapted for specific categories of motor activity. Additionally, claims Kimura, the specified spatial skills of the right hemisphere are due to the evolution of different kinds of motor skills, those that involve the ability to manipulate spatial relationships. Using this line of reasoning, handedness would be responsible for the development of aspects of cerebral asymmetry.

Much of the evidence reviewed by Springer and Deutsch suggests that hemispheric asymmetries in some form are present at birth.

Jerre Levy has argued similarly that the cognitive processes used for language and those used for spatial-perceptual functions are incompatible and therefore the brain had to develop separate processing systems. In clinical cases, where one hemisphere is damaged at birth, sensitive tests reveal hemispheric deficits which persist through development, leading to the conclusion that the basic blueprinting for asymmetry is present at a very early age. It is reasonable therefore, to conclude that genetic factors clearly influence hemispheric organization. Studies also confirm that younger children tend to employ a right-hemisphere style until the demands for left-hemisphere processing of language and specificity increase.

Therefore, hemispheric specialization is probably present from birth, but is shaped further by the demands and input to the brain.

Differences in hemispheric function

According to Springer and Deutsch, the most widely researched and cited characteristics used to describe the processes of the left and right hemisphere are as follows:

Left	Right
Verbal	Nonverbal
Digital	Visuo-Spatial
Sequential	Simultaneous
Rational	Analogical
Logical	Intuitive

The verbal-nonverbal distinction was the first to emerge from studies of split-brain patients. The sequential-simultaneous distinction has its basis in the fact that the left hemisphere tends to deal with rapid changes in time and to analyze stimuli in terms of detail. The right, on the other hand, deals with stimuli simultaneously through patterns. These differences are widely researched and generally accepted.

Other descriptors which enjoy acceptance in many circles, yet are not as widely researched are the following:

Left	Right
Convergent	Divergent
Deductive	Metaphorical
Realistic	Imaginative
Directed	Free
Explicit	Tacit
Objective	Subjective
Successive	Random
Abstract	Concrete/experiential
Analytical	Holistic

Certainly the importance our culture places on words and verbal knowledge has influenced the idea that because the left hemisphere controls (in large measure) our language capability, it is the important one to develop. However, the right hemisphere houses important activities of its own, activities without which we would be unable to function normally. The right hemisphere appears to play a major role in our ability to perceive relationships and see things as integrated wholes rather than as a collection of isolated parts.

In cases of hemispheric damage in children, when the left is damaged, the right hemisphere is capable of developing language skills, but when the right is damaged, the left hemisphere is not capable of developing nonverbal spatial skills. This also suggests that the right hemisphere is better able to subserve the functions of both hemispheres. Also implied from these studies are speculations that routine tasks are the domain of the left hemisphere while the right hemisphere is assigned tasks for which there is no readily apparent code. Thus the right hemisphere is more flexible and able to handle greater informational complexity.

Robert Ornstein, argues that the cerebral hemispheres are specialized for different types of thought. For Ornstein, differences among people derive not from handedness or sex but from a diversity of different talents or preferences for modes of thought. He also insists that schools spend most of their time training students in what seems to be left-hemispheric talents. This idea, that the two hemispheres are specialized for different modes of thought gave rise to the concept of "Hemisphericity," the idea that individuals rely more on one mode (or hemisphere) than another.

According to Joseph Bogen, a neurologist who originated the term hemisphericity, the relationship between brain function and modes of expression is very complex. Therefore, Bogen warns against simplistic "one or the other" classification systems of brain function. This being said Bogen also confirms that while there is considerable interaction of hemispheric function, language is predominantly processed in the left hemisphere. The division of function is not so much between words and symbols as between logic and emotion. When words are directly linked with emotions, as they are in poetry and song, the right hemisphere is operative. But it is the left hemisphere that deals with the language of conceptual thought.

Hemispheric Hardwiring

According to S. H. Woodward, neural patterns in the left hemisphere reflect more tightly connected vertical columns of connectivity, whereas right hemispheric connections reflect weaker and longer horizontal connections. Described as conjunctive (left) and coarse (right) encoding systems these neural patterns differ in that the conjunctive (vertical/left) is designed for highly specific, very compactly organized representations, while the coarse (horizontal/right) is designed for stimulus which is more dispersed and variable.

Note: Neurophysiologists have shown that vertical cortical circuitry dominates the response to stimuli. In the absence of specialization, the left hemisphere's specialization deals with all "unmarked" cases. Therefore, the left hemisphere is "hard wired and primary" dealing with tasks requiring fixation. Conversely, the right hemisphere has the role of subserving and dealing with irregularity and complexity. In this way the left hemisphere deals with cases in which rule and regularity are appropriate and the right hemisphere accounts for all irregular or not previously ruled cases.

Goldberg and Costa combined data from studies revealing that there is more tissue in the right hemisphere with studies suggesting an asymmetry in ratio of gray to white matter in each hemisphere. These researchers assert that these studies (of the ratio of tissue and gray and white matter in each hemisphere) support interregional (connected) neural organization in the right hemisphere and intraregional (alone, individual) in the left.

The Role of the Corpus Callosum

Most experts agree that the corpus callosum functions by updating each hemisphere regarding information received by the other. However, the agreement ends there. Psychologist Norman Cook postulates four possibilities for how the corpus callosum works. These possibilities are as follows: diffuse excitation (arousal of the other hemisphere), topographic excitation (provides carbon copy information to the other hemisphere), diffuse inhibition (shut down of the other hemisphere), and topographic inhibition (activation of complementary aspects of the other hemisphere). Cook believes that the topographic inhibition possibility is most plausible. In topographic inhibition the corpus callosum suppresses in one hemisphere the exact same neuronal pattern of activity that originated in the other, but at the same time allows activity to develop in surrounding neurons representing complementary aspects of the original information.

Cognitive Style and Hemisphericity

Robert Ornstein has written extensively on three dimensions of brain-related cognitive style: 1) high and low amplification, 2) deliberation-liberation, and 3) approach-withdrawal. According to Ornstein with regard to the high and low amplification measure, individuals differ in a specialized brain setting in the thalamus that controls the amount of amplification and stimulation individuals need. High amplification types need quiet and reflection (because they amplify noise) while low amplification types (because their setting is low) need stimulation and noise. A relationship to Watching/Doing, Reflective Observation/Active Experimentation and Extroversion/Introversion is hypothesized here.

The second continuum reported by Ornstein is the deliberation-liberation continuum. Again, according to Ornstein, individuals are set by their brain organization at different levels of control over their daily actions. They are conditioned by the reticular activating system of the brain and influenced by the limbic system and the frontal lobes of the cortex. Ornstein states, "people differ on how much the emotional brain centers impinge on their day to day lives and how easily they keep different parts of their lives apart. For highly controlled, often highly verbal people,

everything in its place, comes naturally, while a more diffuse style is the norm for others, even when not wanted. The more diffuse style is also associated with how intense and changeable someone's emotional responses are." For those of us who understand 4MAT, the type 2 and 3 would be similar to the deliberation style and type 1 and 4 the more emotional, liberation style.

The third aspect of type which Ornstein describes is the Approach/ Withdrawal continuum. This continuum, located in the frontal lobes of the two hemispheres, is said to establish "feeling tone" in individuals and is defined as the degree of emotional responsiveness a person displays with regard to situations of pleasure and pain. According to Ornstein, pleasure is located in the left hemisphere and pain in the right. I have some difficulty with the terms Ornstein uses to differentiate these behaviors. For me, the continuum would be clearer if considered in light of situations for which there is ambiguity and risk (right hemisphere) and situations for which there is a comfort and control based on prior knowledge or experience (left). People experience pleasure when they are in control and also experience a degree of stress when the situation is to be avoided.

Note: According to Ornstein, each of these set points are present at birth and while they can be influenced by environment they remain relatively stable through life. However, some people move their set point more than others.

Gender Differences

In spite of the fact that the majority of the brain's development occurs outside of the womb, there is solid and consistent evidence from scientists that a biochemical influence in the womb determines and directs the structure and function of our brains. Male hormones organize the brain into a male pattern, and the absence of a male hormone means that the brain persists in a female pattern. In describing how the brains of the sexes are different, prominent differences are observable in the organization of the hemispheres. For example, in most females the connections between the hemispheres are more diffuse whereas in most men they are more specific. Most females also have a larger and more bulbous corpus callosum thus facilitating their diffuse organizational pattern and greater facility with using both hemispheres interchangeably. And, finally, in most females verbal functions and emotional centers are located in both hemispheres whereas in most males verbal functions are located primarily in the left and emotion primarily in the right hemisphere.

Results of studies investigating gender differences support the following:

- The difference in visuospatial ability (representing and transforming symbolic information) is the strongest sex difference with most men having greater competence in this area.
- There are also differences in the way men and women visualize themselves in space. Men appear to have superior skill at analyzing space in terms of abstract ideas, while women are superior at remembering how the space was organized.
- Studies also confirm that boys develop their right hemisphere earlier than girls, while girls have earlier left hemispheric lateralization. However, a majority of girls learn to talk before most boys. Females also have better hearing throughout their lives.
- Boys are better with objects in motion, and mathematical relationships, while girls outperform boys at left-hemispheric tasks involving language. Females test better than men on verbal batteries while males do better on mathematical reasoning.
- Boys report being more aggressive than girls and they are also more active, impulsive and mischievous.
- Women are more empathic and develop more intensive social relations. They are more

sensitive to sound, smell, taste and touch and superior to most men in fine motor movements. Women are also more adept at tuning to peripheral information contained in expressions and gestures and process sensory and verbal information faster. They are also less rule bound than men.

Note: Sexual identity tells us nothing about individual mental ability. It is also important to remember that there are females and males that do not fit the general pattern.

Handedness and hemispheric organization

Most researchers agree that handedness is significant to individuality because of the way the hemispheres of the brain are organized. Many postulate that handedness may even be the reason the brain developed different hemispheres. In most right-handed people the left hemisphere is dominant for language, while spatial and visuospatial skills are directed by the right hemisphere.

History upholds that left handedness is viewed with some degree of suspect. And to make matters worse for left-handed people, their brain organization is usually different.

Socio-economic status (SES) and hemispheric preference

Dr. Deborah Waber and her colleagues at Harvard University studied 120 fifth and seventh graders from low and high SES backgrounds. All were Caucasian, right-handed and spoke English as a first language. None had been identified as learning disabled. Using a tachistoscope that flashed words and numbers to the right or left visual field (each of which is connected to the opposite side of the brain), they clearly showed that even though both groups got equal numbers of answers correct, the different SES groups used their brains differently to do so. Even when the effects of IQ were statistically controlled, the high SES children showed a clear pattern of using their left hemisphere more effectively, while equally intelligent low SES children tended to rely upon the right. According to the researcher, these results reflected SES-related variations in the nature of information processing in the two hemispheres. Boys and girls scores did not differ from each other. Waber does not believe that her research implies that these differences are immutable, but rather that they may have resulted from differing life experiences.

These findings have prompted a serious challenge to the way human learning has been conceptualized. As Jane Healy, author of *Endangered Minds* warns, in light of recent research, those teaching models which exclusively emphasize the acquisition of abstract knowledge soon run afoul of the developmental reality that brains learn in different ways and on different schedules. According to Healey, many children, because of different orientations to learning, perform poorly in learning environments which do not diversify instructional tasks.

Summary

Research on hemispheric specialization and brain function support the following:

- The hemispheres of the human brain process information and experience in identifiably different ways.
- The neural organization in each hemisphere is complementary, yet different.
- The Corpus Callosum, the bundle of nerve fibers connecting the two hemispheres, serves to integrate the functions of the hemispheres.

- Hemispheric dispositions (preference) are identifiable.
- Individual preference for hemispheric integration has a supportable relationship to cognitive processing style, especially with regard to new learning.
- Brain research supports the belief that traditional education favors an all too narrow approach to teaching. Our "at-risk" students may be at risk due to our teaching methodologies rather than from any innate deficiencies of their own.
- Research on the effects of right and left mode instruction indicates that students differ with regard to hemispheric dominance, and that these differences influence student retention and performance.

According to these findings most researchers support the idea that thinking and learning calls upon both hemispheres. Therefore, when teachers mix and match the abilities of the two hemispheres so that the most adaptive processing is brought to bear on the learning situation, learner motivation and performance improve.

Bernice McCarthy, author of the 4MAT System, believes that polarized classification abuses of the (Hemisphericity) research do not negate the need for teachers to understand and apply this research. According to McCarthy, teachers need to intentionally design instruction to incorporate the processing skills of both hemispheres in order for learning to be complete. They must understand the right and left mode functions of the brain and they must do so as mindfully as possible.

McCarthy's 4MAT gives all who teach a context for understanding and applying these findings to their individual settings. Conversely, brain research validates the 4MAT System. Therefore, according to McCarthy, it important that all who teach become conversant with these studies and understand their implications for teaching and learning.

This knowledge about the specialization of brain function has led to several hypotheses about how teaching and learning might be improved. In this regard, the guiding principles of the 4MAT Model relating to hemisphericity are as follows:

- Individuals rely more on one mode of processing than another,
- We can characterize these modes of processing as right or left hemispheric dominant,
- Whole brain learning (engaging right and left hemispheres), a goal of The 4MAT Model, is accomplished for different individuals with different methods.

Simply put, meaningful teaching requires that teachers design learning sets which engage both right and left hemispheric abilities.

Section Three:
Bernice McCarthy's 4MAT Model

Bernice McCarthy, drawing heavily upon these brain studies and grounded in the work of John Dewey, David Kolb and Carl Jung, has created a pedagogical model which assumes (1) that individuals learn in different yet identifiable ways, and that (2) engagement with a variety of diverse learning sets results in higher levels of motivation and performance. The following summaries of Kolb's Theory of Experiential Learning and Jung's Theory of Individuation are presented here as examples of the theoretical origins of McCarthy's model.

McCarthy's 4MAT System applies the principles of these long-standing theories to provide teachers with a structure for planning meaningful learning experiences for all "styles" of learners. According to McCarthy, 4MAT deepens the experience of learning by engaging learners in diverse learning sets which require the learner to form and test the limits of his/her understanding. McCarthy's 4MAT System, an eight step model for teaching, is summarized as follows:

Step One —- Quadrant 1 Right

The first step of The 4MAT System is designed to engage the learner in a concrete experience which leads to a search of prior knowledge and prior experience. This search is designed to create an interactive group dialogue which connects what the learner already knows and believes to what the teacher intends to teach. In this dialogue there are no correct answers. Learners experience and compare their perceptions of their existing state of knowledge and work cooperatively to create an overall learning set from which to proceed. In this step the teacher encourages diversification of ideas, dialogue and participation. Note McCarthy's application of Kolb's concrete experience and reflective modes for making sense of the learning environment, as well as the engagement and encouragement of subjective valuation, Jung's feeling function. This step is also designed to encourage relational, symbolic thinking which is a right hemispheric function.

Suggestions for teachers

- Connect students directly to the concept in a personal way.
- Capture students' attention by initiating a group problem-solving activity before delivery of instruction.
- Begin with a situation that is familiar to students and builds on what they already know.
- Construct a learning experience that allows diverse and personal student responses.
- Facilitate the work of cooperative teams of students.
- Elicit non-trivial dialogue from students .

Evaluation:

Engagement, participation in collaborative dialogue and generation of ideas.

Step Two— Quadrant 1 Left

The second step of McCarthy's 4MAT System, quadrant one left, is designed to add process judgment to the perceptions and dialogue generated in step one. In this teaching set, the teacher engages student reflection upon their existing level of their knowledge and experience to determine if their opinions and beliefs are supportable. The emphasis here is not to qualify or bring closure to student thinking. In quadrant one (right and left) the goal is engagement. However,

in quadrant one left the teacher's role is to assist student as they demystify and pattern their thinking. In quadrant one left, beliefs and opinions begin to evolve into organizers and structures for future thinking and theory building. This phase of The 4MAT Cycle emphasizes left hemispheric thinking and therefore has as its goal the imposition of structure.

Objective:

Examine the Experience.

Suggestions for teachers

- Guide students to reflection and analysis of the experience.
- Encourage students to share their perceptions and beliefs.
- Summarize and review similarities and differences.
- Establish a positive attitude toward the diversity of different people's experience.
- Clarify the reason for the learning.

Evaluation:

The quality of students' analyses of their collective subjective world of experience. Students ability to explore stated feelings by listening, listing, patterning, prioritizing, stating their own reflections

Step Three— Quadrant 2 Right

Step three of the 4MAT System is designed to create a context for the learner to represent the subjective nature of his/her existing knowledge as a preparation for the validation and analysis of ideas. In this step learners are encouraged to symbolize, in as many modalities as feasible, their present state of understanding of the subject matter. Image making, central to this step, is a right mode activity. The emphasis here is the expansion of representations of meaning. However, this step requires the learner to begin to shift from reflective experience to reflective thinking. The teacher's role here is to draw attention to aspects of structure and objectivity implicit in the students representations of what they know.

Objective:

Integrate personal experiences into conceptual understanding.

Suggestions for teachers

- Provide a metaview, lifting students into a wider view of the concept.
- Use another medium (not reading or writing) to connect students' personal knowing to the concept (i.e. visual arts, music, movement, etc.).
- Involve learners in reflective production that blends the emotional and the cognitive.
- Transform the concept yet to be taught into an image or experience, a "sneak preview" for the students.
- Deepen the connection between the concept and its relationship to the students' lives.
- Relate what the students already know to what the experts have found.

Evaluation:

Quality of student production and reflection

Step Four— Quadrant Two Left

Step four of the 4MAT System engages students in objective thinking. The emphasis here is analysis of verifiable concepts, facts, generalizations and theories. The role of the teacher is to present information and experience in complete and systematic ways. The good "two -left" lecture builds upon the personal connections established in quadrant one to foster conceptual thinking. This is a left mode teaching set. Note: This is McCarthy's application of Kolb's abstract conceptual, reflective mode as well as Jung's thinking function.

Objective:

Define theories and concepts.

Suggestions for teachers

- Provide "acknowledged body of knowledge" related to the concept.
- Emphasize the most significant aspects of the concept in an organized, organic manner.
- Present information sequentially so students see continuity.
- Draw attention to important, discrete details; don't swamp students with myriad facts.
- Use a variety of delivery systems: interactive lecture, text, guest speakers, films, visuals, CAI, demonstrations, etc. when available.

Evaluation:

Teacher verbal and/or written checking for student understanding

Step Five— Quadrant Three Left

In step five of the 4MAT System the emphasis shifts from acquisition and assimilation to testing and adaptation Students now take the lead to apply what has been taught. In quadrant three left the goal is reinforcement and diagnostic evidence of the student's ability to apply the concepts taught. The teacher's role here is coaching and assisting as students refine their ability to find applications of their ideas. This teaching set engages Kolb's abstract concepts in action and Jung's extroverted sensing functions. It also models Dewey's idea that knowledge must be tested in the environment. Because the emphasis of this teaching/learning set is left mode, correct answers and student products which demonstrate their ability to apply the concepts are important here.

Objective:

Working on Defined Concepts (Reinforcement and Manipulation)

Suggestions for teachers

- Provide hands-on activities for practice and mastery.
- Check for understanding of concepts and skills by using relevant standard materials, i.e. worksheets, text problems, workbooks, teacher prepared exercises, etc.
- Provide opportunities for students to practice new learning, perhaps in multi-modal ways (learning centers, games fostering skills development, etc.)
- Set high expectations for skills mastery.
- Use concept of mastery learning to determine if re-teaching is necessary and how it will be carried out.
- Have students create additional multi-modal practice for each other.

Evaluation:

Quality of student work, perhaps an objective quiz

Step Six— Quadrant Three Right

Step Six of The 4MAT System exemplifies John Dewey's idea of the student as a scientist. In this learning set the student tests the limits and contradictions of his/her understanding. The teacher's role is to encourage students to take the application of learned ideas to more sophisticated, personal levels. Students are encouraged to develop their own applications which demonstrate that they understand and can apply what has been learned. Project work is the essence of this phase of the 4MAT Model. The right mode emphasis in this learning set is designed to encourage students to create personal applications their experiences with the ideas learned.

Objective:

"Messing Around" (Adding Something of Themselves)

Suggestions for teachers

- Encourage tinkering with ideas/relationships/connections.
- Set up situations where students have to find information not readily available in school texts.
- Provide opportunity for students to design their own open-ended explorations of the concept.
- Provide multiple options so students can plan a unique "proof" of learning.
- Require students to organize and synthesize their learning in some personal, meaningful way.
- Require students to begin the process of planning how their project will be evaluated, identifying their own criteria for excellence.

Evaluation:

Students on-task behavior and engagement in their chosen options

Step Seven— Quadrant Four Left

Step seven of The 4MAT System requires the learner to critically examine the place of the newly acquired knowledge and experience in his/her existing world view. The central issue here is what new questions do I have and what must be done to integrate this learning into a meaningful conceptual subset. Working alone or preferably in pairs and triads, learners in this learning set edit and refine their work. They also face and resolve contradictions implicit in the tension between new and earlier schema. The teacher's role here is to guide the refinement of the old schema and encourage the formation of a more complete perspective. Note the requisite of this step to objectify intuition.

Objective:

Evaluating for Usefulness and Application

Suggestions for teachers

- Give guidance and feedback to students' plans, encouraging, refining, and helping them to be responsible for their own learning.

- Help students analyze their use of the learning for meaning, relevance, and originality.
- Maintain high expectations for completion of chosen options.
- Help mistakes to become learning opportunities.
- Summarize by reviewing the whole, bringing students "full circle" to the experience with which the learning began.

Evaluation:

Students' willingness and ability to edit, refine, rework, analyze, and complete their own work

Step Eight— Quadrant Four Right

The essence of step eight in The 4MAT System is integration, celebration and closure. In this, the last of McCarthy's learning sets, the learner returns to the place where he/she began, the self, and integrates the learning experience into a slightly different, personally held world view. This is the step where presentations are given, where poems are recited, where letters are mailed and research reports submitted. The teacher's role is to join in the celebration and facilitate entry into the next unit of study.

Objective:

Doing it Themselves and Sharing What They Do with Others

Suggestions for teachers

- Support students in learning, teaching, and sharing with others.
- Establish a classroom atmosphere that celebrates the sharing of learning.
- Have opportunity for students to practice new learnings.
- Make student learning available to the larger community, i.e. books students write are shared with other classes; students report in school paper; student work is displayed throughout the school; etc.
- Leave students wondering (creatively) about further possible applications of the concept, extending the "what ifs" into the future.

Evaluation:

Students ability to report and demonstrate what they have learned. Expressions of student enjoyment in the sharing of their learning. Quality of student final products.

Research Support

Bernice McCarthy and her associates have conducted extensive action research on the effects of the 4MAT Model. Their work clearly demonstrates that 4MAT, appropriately used: (1) validates learners, (2) increases learner motivation, (3) improves academic performance and (4) encourages personal development by intentionally representing experience and knowledge in varied yet connected ways.

Dissertations and action research investigating the specific effects of the 4MAT Model indicate that appropriately used, 4MAT positively impacts the following:

- Levels of student involvement on academic learning tasks
- Attitude and achievement in science
- Reduction in remediations necessary for student mastery
- Student self-esteem and behavior
- Attitude and achievement in fine arts
- Acquisition of study skills strategies
- Performance in geometry
- Performance on standardized tests
- Retention on content measures
- Interest and attitudes to instructional activities in science
- Teacher implementation of innovation using 4MAT
- Teacher attitudes toward diversity
- Teacher purposefulness and planning
- Teacher employment of diverse learning sets
- Teacher transfer of teaching innovations
- Incorporation of creativity in teaching
- Adult learning and retention

Therefore, many validated studies provide convincing evidence that 4MAT can have positive and significant effects upon student performance and attitude. Also that s a model for staff development, 4MAT is philosophically, theoretically and structurally suited to the development of purposeful, creative unit plans.