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Learning styles: A student guide to self-assessment and accommodation

Donna Lou Shea

LEARNING STYLES: A STUDENT GUIDE TO SELF-ASSESSMENT AND ACCOMMODATION

A Project

Presented to the

Faculty of

California State University,

San Bernardino

In Partial Fulfillment

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ABSTRACT

This project presented adult students with a self-assessment guide for the identification and accommodation of their individual learning style. Furthermore, it attempted to draw a bridge between the educational behavior psychologists and the lateralist neuroscientists via application of brain mapping, described a process that identified specific cognitive focal areas while establishing the cooperative function of the brain in total.

A textbook proposal presented self-assessment tools and references with easily applied strategies for different learning styles and multiple intelligences. The project's goal was to encourage skill development to enhance the educational experience and promote greater academic success for the adult learner. Through examination of current educational trends and issues, as well as the unification of current theorists, the anticipated result of this proposal was an understanding of metacognition and identification of individualized learning styles.

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DEDICATION

To learn about fetal brain development is to experience the incredible beauty of the brain unfolding into a "mindful" person well before birth; to learn about lifelong brain development is to ponder the brain's capacity for increasing synaptic connections throughout life; to learn about the power of mind/body connections is to consider the awesome possibilities of unlocking human potential at every point along our journey through life (Languis, 1998).

Dedicated to

My Mother

Mindalyn Ervin Eslinger

who, through her faith in me, taught me the awesome possibilities of my own potential.

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CHAPTER ONE

Background

Introduction

Chapter One presented an overview of the project. It included a contextual discussion of the problem followed by an introduction to the purpose and significance of the project with a review of the applicable limitations and delimitations. A review of literary sources established the relevance and effectiveness of learning styles as applied to the adult educational experience. Sources and theories prompting this project originated from two basic groups, educational behavior psychologists and lateralist neuroscientists. The chapter concluded with operational definitions of terms.

Context of the Problem

Recorded debates between teaching methodologies trace back to Plato's Idealism, which employed the Socratic method of provocative questioning, and the Sophists, who focused on skills based education. These factions broadly equated with contemporary scholastic versus vocational education arenas. Scholasticism adopted the traditional lecture approach to presenting information, whereas vocational education presented competency-based curricula (O'Brien, 1989; Ornstein & Levine, 1997).

Today's educational system is in a state of flux resulting from the many academic philosophies at work in the United States in conjunction with rapid decisive changes in our world today (Gardner, 1999; Ornstein & Levine, 1997). Esler (1984) observed dichotomized opinions between Gagneian/Skinnerian behaviorists and holistic theorists like Piaget and Bruner. If one subscribed to Kuhn's Paradigm Change Model, the educational system has cycled through a state of chaos and normal science. Modern education was in a state of crisis demanding a paradigm shift into extraordinary science destined to become tomorrow's normal science (Appendix A, Figure 1) (Gehring, 1999). This, combined with the many philosophies and learning style models available, led to inconsistency in education from which the students suffer (Billington, 1998). Research suggested that adult learners were the most vulnerable because while state regulations and district policy imposed some consistency on K-12 institutions, no such continuity existed for the myriad of adult learning institutions and environments. Consequently, the adult educational model varied, almost on a classroom to classroom basis, as autonomous educators established individual protocols founded on personal preference and comfort rather than student needs (Spoon & Schell, 1998; Williamson, 1998).

Adult learners acquired knowledge in different ways, which demanded adult educators have a command of varied learning styles and methods to accommodate them (Spoon & Schell, 1998). Yet, typical adult educators entered teaching from a career base with no knowledge of teaching methodology and skills. Vocational educators, initially hired based on life experience and area specific knowledge, received little, if any, classroom presentation training (Spoon & Schell). Some did attended seminars and in-service teacher training presentations to satisfy required Continuing Education Units (CEUs) for state licensure. However, once vocational educators achieved a "comfort zone" in standards, curricula content, and presentation methodologies, many were reluctant to embrace new ideas when presented (Williamson, 1998).

Adult learners experienced only limited success in such a convoluted environment. One possible solution was to provide the learner with tools to assess and accommodate personal learning styles sans intervention from an outside source (O'Brien, 1989). This proposal outlined a text directed to the adult learner. It provided self-assessment tools and strategies for self-directed study including various learning style models and multiple intelligence evaluators to enable the adult learner to identify the most

productive personal approach. This publication's goal was to empower adult learners to excel with instructors knowledgeable in learning style methodology and survive instructors who do not accommodate learning styles in their presentations. There was no intent to relieve educators of their responsibility in accommodating individual preference, but to enable adult learners to survive academic environments lacking in learning style practices.

Purpose of the Project

The purpose of this project was to develop a textbook proposal, entitled *Learning Styles: A Student Guide to Self-Assessment and Accommodation*, for submission to a national publishing house. A target audience of post-secondary adult learners in proprietary institutions dictated the design. The proposal identified the need for adult learners to be cognizant of their learning style preferences as well as how to accommodate those preferences to ensure academic success. Each chapter presented an overview of a specific learning style or multiple intelligence with suggestions for strategies to accommodate that preference. Appendices included evaluation instruments as well as citations for additional self-assessment tools, study of methodologies and current resources for additional reading.

Significance of the Project

The educational community broadly recognized the validity of accommodating learning styles. However, the disparity between this recognition and the application of a teaching methodology that addressed learning styles prevented the vast majority of adult learners from benefiting from this knowledge. This project took advantage of adult learners' need to assume ownership of their educational experience. By presenting information on self-assessment and accommodation of learning styles, adult learners were empowered to develop strategies that ensured academic success.

Assumptions

Two assumptions issued during this project's development. First, that publication of the research project was feasible and practical. Creation of a World Wide Web site offered an alternative to reaching the target audience if the interest of a national publishing house was not forthcoming. The second assumption was that if delivery of the information was concise, easy to follow and implement, adult learners would avail themselves of the assessment tools, strategies, and resources presented.

Limitations and Delimitations

The following limitations and delimitations pertain to the development of this project.

Limitations.

1. The target population for this textbook proposal was adult learners in post-secondary vocational education.
2. This project could not address the plethora of past educational experiences presented by the target population.
3. This project was unable to keep abreast of the sheer scope of research information continually explored and formulated.
4. Effectiveness of this project was limited to the acceptance and application of the information by the adult learner.

Delimitations.

1. This project generalized to adult learners seeking post-secondary education in traditional institutions.
2. Utilization of appropriate marketing venues such as a national publishing house or the World Wide Web offered unlimited access to diverse populations such

as educators, administrators, and potential scholars of all ages.

3. Success of this project in the adult arena could lead to adaptation for implementation within primary and secondary educational environments.

Definition of Terms

The following offers operational definitions of terms as they apply to this project.

- 4MAT: An instructional model which states all information must be presented to all students using all four of the modalities outlined in Kolb's learning model (Kaplan, 1998).
- Accommodators: One of four learning styles based on Kolb's learning cycle, a person who uses active experimentation and concrete experience to assimilate data (Indiana State University, 1999).
- Affective domain: Learning that arises from emotions, feelings, attitudes, and values ("A neural network," 1998).
- Arousal/attention unit: One of three functional units identified in Luria's model, comprised of the brainstem, which regulates the tone of the waking mental state

enabling the individual to maintain focus (Languis & Miller, 1992).

- Assimilators: One of four learning styles based on Kolb's learning cycle, a person who uses abstract conceptualization and reflective observation to assimilate data (Indiana State University, 1999).
- Auditory learner: Learner who prefers verbal instruction and oral delivery systems (Bell, 1998; Nolan, 1990)).
- Bodily/kinesthetic: Intelligence that excels at handling objects and physical use of the body (Learnativity, 1999).
- Brain mapping: Diagnostic studies capable of identifying localized brain functions (Dryer, Beale, & Lambert, 1999; Ornstein & Levine, 1997).
- Cerebellum: The portion of the brain located at the back of the head, which controls and coordinates motor functions ("A neural network," 1998).
- Cerebrum: The largest portion of the brain, divided into right and left hemispheres, where loci for muscle response, auditory, visual, speech and higher thought processes reside ("A neural network," 1998).

- Cognitive domain: Learning through trial-and-error based on thoughtful interpretation of sensory stimuli ("A neural network," 1998).
- Cognitive loci: Specific location in the brain where thought processes occur relevant to a specific task (Posner, 1997).
- Cognitive science: The study of the mind (Gardner, 1993).
- Convergers: One of four learning styles based on Kolb's learning cycle, a person who uses active experimentation and abstract conceptualization to assimilate data (Indiana State University, 1999).
- Cortical tone: The degree of mental arousal necessary for thought in the way that muscle tone is necessary for movement (Languis & Miller, 1992).
- Critical [directed] thinking: Applying cognitive skills or strategies that increases the probability of success (Halpern, 1996).
- Crystallized knowledge: Long-term memory used to process fixed answer questions (Smith & Jonides, 1997).
- Deductive reasoning: Formulating conclusions through logical inference from a stated premise (Halpern, 1996)
- Divergers: One of four learning styles based on Kolb's learning cycle, a person who uses concrete experience and

reflective observation to assimilate data (Indiana State University, 1999).

- Domain dependent: Crystallized knowledge, for example names processed and stored in related hemispheric loci of the brain (Prabhakaran, Smith, Desmond, Glover & Gabrieli, 1997).
- Domain independent: Fluid memory, such as problem solving, which does not reside in specific loci but is a total brain function (Prabhakaran et al., 1997).
- Event-Related Potentials (ERPs): Process of recording the electrical response in the brain to external stimuli via an electroencephalogram (Bigler, Lajiness-O'Neill, & Howes, 1998).
- Executive planning/organization unit: One of three functional units identified in Luria's model, located in the frontal and prefrontal lobes of the cerebrum that regulates and verifies activity, impulse control, spontaneous speech and other human intellect and higher thought processes (Languis & Miller, 1992).
- Inductive reasoning: Formulating a conclusion or hypothesis from a collection of observations (Halpern, 1996).

- Intelligence: The ability to answer items on tests of intelligence (Gardner, 1993).
- Interpersonal: Intelligence that demonstrates an understanding of people and relationships with a preference for working in groups (Halpern, 1996; Learnativity, 1999).
- Intrapersonal: Intelligence that relies on emotion to understand oneself and others with a preference for working independently (Halpern, 1996; Learnativity, 1999).
- Ions: Electrically charged chemical elements, which enable proteins to form memory links (Learnativity, 1999).
- Learning styles: Method of collecting, processing, internalizing and retaining new information (Dunn, Griggs, Olson, & Beasley, 1995; Spoon & Schell, 1999).
- Logical/mathematical: Intelligence that is responsive to chains of reasoning, pattern recognition and order (Learnativity, 1999).
- Long-term memory: Synaptic ability to transmit stimuli hours to years following an event (Esler, 1984).
- Metacognition: Knowledge about, or understanding of, how learning occurs (Halpern, 1996).

- Midbrain: The central area of the brain located below the cerebrum, which acts as a switchboard between the cerebellum and the two hemispheres of the cerebrum ("A neural network," 1998).
- Multiple intelligences: Content specific approaches to processing information identified as musical/rhythmical, bodily/kinesthetic, logical/mathematical, verbal/linguistic, visual/spatial, interpersonal, and intrapersonal (Gardner, 1993).
- Musical/rhythmical: Intelligence that is sensitive to patterns such as pitch, melody, rhythm, and tone (Halpern, 1996; Learnativity, 1999).
- Neural pathways: Series of nerves separated by synapses that form the pathways established during thought ("A neural network," 1998).
- Neuroscience: The study of the brain (Gardner, 1993).
- Positron Emission Tomography (PET) scan: X-ray of blood flow through the brain using a radioactive tracer injected into the blood stream (Smith & Jonides, 1997).
- Psychomotor domain: Learning through activities that require voluntary muscle control and hand-eye coordination to complete a given task ("A neural network," 1998).

- Sensory input/integration unit: One of three functional units identified in Luria's model, consisting of the sensory and association areas of the cerebrum, which receives, analyses and stores information (Languis & Miller, 1992).
- Short-term memory: Temporary synaptic ability to transmit stimuli within seconds to minutes of an event (Esler, 1984).
- Simultaneous activity: A right hemisphere function that integrates the parts to form a whole concept similar to inductive reasoning (Languis & Miller, 1992).
- Successive activity: A left hemisphere function that provides sequential processing to create order similar to deductive reasoning (Languis & Miller, 1992).
- Synapses: Small quasi-stable spaces between nerve cells that contribute to thought processes by transmitting stimuli ("A neural network," 1998).
- Tactile [kinesthetic] learner: Learner who requires activities that offer hands-on practice (Bell, 1998; Nolan, 1990).
- Verbal/linguistic: Intelligence that is sensitive to word meaning and word order (Learnativity, 1999).

- Visual learner: 1) Learner who converts sensory input into images in the brain and prefers written material (Bell, 1998; Nolan, 1990), 2) Learner who requires pictorial images such as graphs, charts, diagrams, and pictures (Ellis, 1991).
- Visual/spatial: Intelligence that attempts to accurately perceive and recreate the world (Learnativity, 1999).
- Wernicke's area: A portion of the midbrain that receives, encodes, and sorts input for direction to other areas of the brain (Languis & Miller, 1992).
- Working memory: Short-term memory required for analysis and problem solving (Smith & Jonides, 1997).

Organization of the Project

Divided into four chapters, Chapter One introduced the context of the problem, purpose of the project, significance of the project, limitations and delimitations, and definitions of terms, as they applied to this project. Chapter Two consisted of a review of relevant literature. It addressed the behavior psychologist vs. the lateralist neuroscientist perspective and attempted to reconcile the two factions through brain mapping, which also established the relevancy and validity of learning style accommodation providing justification for this project. Chapter Three

discussed the methodology in preparing the thesis project. Chapter Four presented conclusions and recommendations prompted by the development of the project. References followed Chapter Four. The Appendix consists of figures. Finally, the project presented the textbook proposal outline, self-assessment instruments, and student resources followed by the project references.

CHAPTER TWO

Review of the Literature

Introduction

From basic to complex, learning consisted of increasing knowledge, remembering information, gaining knowledge for practical uses, abstracting meaning from activities, and understanding what has been acquired (Learnativity, 1999). Literary resources reviewed in this chapter included the earliest specialists in this field as well as current trendsetters and their issues. Learning surveyed as a physiological process focused on critical or directed thinking.

Diane Halpern (1996) defined critical or directed thinking as increasing the probability of a desirable outcome by employing cognitive skills and/or strategies. Halpern further suggested that different people preferred different modes of thought and that success required "being mindful" or conscious and concerned about the thinking process. A new term, metacognition, was coined to identify knowledge about how one learns. Metacognition and many of its aspects were included later in this chapter.

Increasing knowledge is a vital part of an individual's growth, which constitutes a significant part of the learning process and, as such, is inseparable from learning.

Measurable growth is largely physiological in children, but in physically mature adults, demonstrable growth must follow mental and emotional pathways (Billington, 1998). Cited studies addressed the next logical question: Does this also imply that adults learn differently than children? One representative study indicated young children use right-brained visual-spatial strategies to learn to read; older children shift to a left-brain linguistic approach; and by adulthood, reading becomes a balanced hemispheric function. This study suggested, and seemed to support, the theory that adults approach learning differently than developing children (Dryer et al., 1999). In summary, to increase knowledge and continue to learn, even adults must continue to grow; conversely, cessation of growth results in cessation of learning as well (Billington, 1998).

Billington (1998) further identified the following seven characteristics necessary for an effective environment to facilitate adult learning:

- A safe environment that meets learners' needs and recognizes life achievements.
- An environment that encourages creativity, freedom and experimentation.
- Faculty that interfaces with adult learners as peers and remain open to learn from their students.

- A program that encourages students to take ownership of the learning experience and offers the opportunity to meet individual learning needs.
- Pacing that challenges growth while maintaining a realistic tension level to avoid discomfort.
- Opportunity for proactive adult learners to participate in interactive learning.
- Feedback mechanisms that not only provide learners with consistent performance evaluations but also ensure learners a voice.

These seven criteria supported Carl Rogers' concept of the active learner. The learning process must be self-initiated and pervasive, the evaluation locus must reside with the learner, and the learning experience must be meaningful to the learner (Corey & Corey, 1997).

With this knowledge, it became incumbent that researchers answer the question of how to alter the learning experience to accommodate adult learners. While traditional approaches to presenting and measuring information principally utilized verbal/linguistic and logical/mathematical techniques, other strategies were equally important for success in life and should be incorporated into the adult learning experience (Corey &

Corey, 1997). Understanding why one person learns differently from another and accepting that both are equally valid holds great power (Martin & Potter, 1998). Initial influences on how individuals acquired knowledge included the context in which information was learned and the application method. Studies supported that adult learners preferred specific learning styles to gain knowledge. Therefore, adult educators needed to be cognizant of learning styles, defined as the method in which new information is collected, processed, internalized and retained (Dunn et al., 1995; Spoon & Schell, 1999). Rather than believing themselves unable to learn certain information, adult learners then achieved academic success by taking responsibility for identifying and accommodating individual learning style preferences (Learnativity, 1999; Shaunessy, 1998).

Learning Styles and Multiple Intelligences

Numerous existing learning style models were classified in three ways (Learnativity, 1999):

- Perceptual modalities are biologically based methods of acquiring data from the physical environment.
- Information processing pertains to a preferred method of perceiving, organizing, retaining and processing data.

- Personality patterns attend to values, emotions, and awareness of different situations.

In all three, the components of preferred learning styles included how the student concentrated, processed, internalized, remembered, and recalled information. Individuals could learn anything by capitalizing on the strength of their unique learning style (Shaughnessy, 1998). A study involving three middle schools supported Shaughnessy's belief. Each school, employing a different learner-centered approach (multiple intelligences, learning styles, and brain-based), was equally effective because all accommodated personal preferences (Guild & Chock-Eng, 1998).

Unfortunately, parents expected many average learners to follow the traditional methodology of studying in quiet, secluded surroundings. Challenging the parents' paradigm, by playing music during study for example, resulted in reprimanding the child who was then forced to comply with the parent's concept of an acceptable learning environment. This frequently resulted in poor performance and a lowered self-esteem, which followed the learner into adulthood. Understanding metacognitive processes empowered the student to succeed through applied individualized strategies (Martin & Potter, 1999). This became even more critical for college and adult learners who realized even greater benefits from

learning style accommodation than children (Dunn et al., 1995).

Development of various learning style models addressed the issue of learning preferences. James Bell (1998) differentiated between three learning styles. 1) Visual learners, who converted sensory input into images in the brain, preferred written material. 2) Verbal instructions and oral delivery systems of information were optimal for auditory learners. 3) Tactile learners, who frequently became restless in traditional sedentary environments, required activities that offered hands-on situations. David Ellis (1991) explains how Harry Reinert's 1986 learning style identification exercise took Bell's model one step further by dividing visual learners into those who preferred written words and those who preferred pictorial images like graphs, diagrams and charts. The identification of these learning styles grew from the concept of a learning cycle.

According to Indiana State University (1999), in 1984 Kolb established an experimental learning cycle based on four quadrants (Appendix A, Figure 2). Kolb identified the horizontal axis as active experimentation and reflective observation. His vertical axis differentiated concrete experience from abstract conceptualization. The four quadrants separated learners into accommodators, divergers,

convergers, and assimilators. Kolb viewed the educator's role as facilitating learners through all four quadrants. 4MAT, an adult learning model based on Kolb's four quadrants, followed McCarthy's natural learning cycle (Kaplan, 1998). It identified information as perceived and processed four ways: Connecting the information to personal meaning, obtaining expert information, repetitive application of the information and generalizing the information to real life problem solving. In keeping with Kolb's concept of an educator, supporters of 4MAT believed in presenting all information to all learners using all four modalities (Kaplan). However, the rigidity of 4MAT did not allow for individualized instruction and methodology. In order to decide which method to employ, the individual or the institution needed to establish criteria with which to evaluate the effectiveness of these learning models as they pertained to themselves and/or their student body (Martin & Potter, 1998).

The Indiana State University Center for Teaching and Learning Styles Web page (1999) provided an index of learning style models based on approaches. Social interaction models included the Perry model of four developmental stages in college, Belenky's model based on social strategies for acquiring knowledge, and the Baxter

Magolda model that integrated the Perry and Belenky models into four stages including variations within each stage. In contrast, Myers Briggs incorporated Kolb's information processing model with personality types to identify world-views that influenced the learning process.

Perhaps the most comprehensive was the Dunn and Dunn Learning Style Model, founded on seven principles and 23 components. This model included physiological traits, time of day, mobility, environment, sociological background, emotional state, processing preference and intake-while-concentrating preference principles, among others (Dunn et al., 1995). By incorporating biological, developmental and social factors into the model, it offered highly individualized assessment and accommodation.

Howard Gardner (1993) took a slightly different research approach leading to the concept of seven multiple intelligences identified as musical/rhythmic, bodily/kinesthetic, logical/mathematical, verbal/linguistic, visual/spatial, interpersonal, and intrapersonal. Gardner submitted all intelligences form the core of human thought but individuals became "at promise" (highly skilled) or "at risk" (lacking ability) in applying specific intelligences. Therefore, the dominant focus on traditional verbal/linguistic and logical/mathematical presentations

placed students who excelled in one or more of the other intelligences at an educational disadvantage. According to Gardner, learning styles identified a single preference regardless of content, whereas multiple intelligences addressed content specific approaches.

In spite of the evidence supporting learning styles and multiple intelligences, educational researchers could not reach a consensus on the validity of learning strategies. Gardner (1993) admitted to the absence of experimental testing of his multiple intelligences theory, but argued empirical evidence collected from practical application in the classroom supported his theory. Furthermore, relevant studies identified a correlation between accommodating students' learning style and grade point average (Dunn, 1998). In opposition, McKeachie (1995) argued learning styles were habits or preferences that could be developed or changed at different points in time while simultaneously contradicting himself by encouraging educators to provide students with strategies to match preferred learning styles. According to McKeachie, motivation, intelligence, and prior knowledge were more important than learning styles. Conversely, Shaughnessy (1998) listed motivation as only one of twenty-three learning style elements that contributed to a positive learning experience. Shaughnessy admonished

against addressing learning styles individually, and suggests viewing them as a construct of variables forming a unique pattern. In further opposition to McKeachie, Sonnier (1985) cited a number of sources that supported a holistic approach based on the lateralist theory of hemispheric information processing. Sonnier contended quantity of education was a left-brain cognitive function while quality of learning was an intuitive right-brain function.

These confounded results in adult learning style research could be attributed to an adult learner's ability to adapt years of experience in different types of learning environments to traditional teaching methodology (Spoon & Schell, 1999). In summary, the ability to adapt enabled adult learners to survive traditional educational delivery systems. However, adaptive abilities did not empower adult learners to excel or gain full measure from the traditional instructional approach (Spoon & Schell).

Behaviorists vs. Lateralists

Those investigating metacognition (how we learn, remember and think) fell into separate factions. Traditional behavioral psychologists argued metacognition from a mental functioning point of view whereas lateralist neuroscientists explored information processing in terms of physiological functions based on brain structures (Bruer, 1999; McKeachie,

1995). An analogous description might be that psychologists studied mental software and neuroscientists studied neural hardware (Bruer). This dichotomy was promoted because each school of thought contended that it was right and the other was wrong resulting in two juxtaposed forces within the educational system (Sonnier, 1985). Behavioral psychologists supported a whole-brain approach, stating both hemispheres were involved in even the simplest undertakings (Bruer). Conversely, lateralists contended that each hemisphere operated discretely for specific functions although some tasks required that both hemispheres work in concert (Sonnier).

During the past 15 years, cognitive neuroscientists began studying how "neural hardware" ran "mental software." In other words, how brain structures affected brain functions such as thinking and learning (Bruer, 1999). Interpreting sensory input, controlling motor activity and higher thought processes took place in the cerebrum, the largest portion of the brain ("A neural network," 1998). Tradition considered the right brain to process spatial functions involved in creative, intuitive and artistic thought. Reason and analytical functions involved in reading, writing, speech and mathematics were attributed to left-brain control (Bruer; "A neural network;" Sonnier,

1985). Consequently, lateralists contended learning style preference was determined by lateral brain dominance with the affective domain residing in the right hemisphere, the cognitive domain residing in the left hemisphere, and the psychomotor domain requiring the cooperation of both hemispheres ("A neural network;" Sonnier).

Behaviorists argued that our current knowledge of cognitive functions came from psychological, not biological, science. To that extent, they contended brain-based research provided only supportive evidence of psychological research (Bruer, 1999). In opposition to lateralism, McKeachie (1995) stated the most over generalized application of learning styles was "right-brain" versus "left-brain" dominance. He further argued that undesirable results occurred by deeming learning styles as fixed. McKeachie suggested learning preferences not be viewed separately, but should be considered as existing along a continuum on which learning dimensions differed.

Asymmetries within the human brain exist on a functional and structural level (Dryer et al., 1999). Brain science also established that linguistic symbols were processed differently than numeric symbols, each occurring in separate hemispheres (Gardner, 1999). This dual nature theory of the brain was supported when patients suffering

unilateral brain damage on the left lost mathematical proficiency but retained right-brain visual-spatial abilities (Sonnier, 1985).

Behavioral psychologists and neuroscientists did agree on one point: The mind and brain should be studied independently (Bruer, 1999). This posed the problem of separating the structure from its function. To prove successfully that "neural hardware" did run "mental software," a relationship had to be established and the processes identified without the benefit of studying both simultaneously. Studies demonstrated similarities in structural organization found in all humans, but the individual differences led Languis (1998) to question whether structure followed function or vice versa. Admittedly, traditional behavioral experiments provided the bulk of memory research but recent advancements in neural imaging provided the ability to study memory acquisition on behavioral and neural levels concurrently (Smith & Jonides, 1997). Advancements in neural imaging allowed Languis to respond to the debate concerning which view significantly influenced learning style preference. Therefore, an understanding of brain physiology when applied to behavioral research may facilitate unification of these two factions (Esler, 1984).

Physiology of the Brain

Anatomical studies showed that the brain was comprised of three main divisions, the cerebellum, the cerebrum, and the midbrain. The cerebellum, located at the back of the head, controlled and coordinated motor functions. As the largest portion of the brain divided into right and left hemispheres, the cerebrum initiated muscle response and higher thought processes, (Appendix A, Figure 3). Located below the cerebrum, the midbrain functioned as a switchboard. It relayed messages between the hemispheres of the cerebrum, allowed communication between the cerebrum and cerebellum, and directed sensory input to the appropriate areas of the brain for interpretation, (Appendix A, Figure 4) (Esler, 1984).

At the cellular level, thought or learning consisted of electrically charged chemical elements called ions and specifically arranged intricate cellular material comprised of proteins (Learnativity, 1999). Built from amino acids, these proteins caused the neural pathways to thicken and shorten, stimulating the formation of potassium and sodium ions that supplied the ability to transmit signals. These neural pathways consisted of nerve cells separated by small quasi-stable spaces called synapses, (Appendix A, Figure 5). As experience formed and reinforced neural pathways through

experience, learning occurred ("A neural network," 1998). Memory was the re-creation of neural patterns established during previous experiences. In short-term memory, these chemical reactions were unstable and temporary. The thicker the synapse and the larger the numbers of interconnected synapses, the more stable and long-term the event memory. Both quantity and quality of neural clusters established through activity impacted memory (Esler, 1984). Consequently, the more abundant the activity, the greater the brain's ability to learn and remember and the more passive the experience, the quicker the decay (Esler; Gardner, 1999). This phenomenon gave rise to the theory of long-term and short-term memory.

Short-term memory resulted when synapses achieved a temporary ability to transmit stimuli (data) within seconds to minutes of an event. In long-term memory recall occurred hours to years following an event (Esler, 1984). Recent studies also identified a relationship between stable synapses and learning. Positive reinforcement achieved stability between input, learned information, and output, like speaking and writing (*"A neural network,"* 1998). Short-term memory formed unstable protein clusters that rapidly broke down. Long-term memory resulted from repetitive stimuli forming permanent thickening of protein material

arranged in clusters, which increased the synaptic ability to transmit impulses (Esler). Information more frequently transmitted established a more stable synapse and reduced the incidence of decay. Synapses used less frequently were more inclined to break down and grow new axons in random directions to form new neural pathways. Learning, memory and forgetting were direct functions of synaptic physiology ("A neural network"). In brief, long-term memory was dependent upon quantity and frequency. If quantity was lacking, short-term memory resulted; lack of reinforcement (frequency) resulted in decay leading to forgetting the event or information (Esler; "A neural network").

When viewed as a direct result of strengthening synaptic formation through repetition, memorization explained inherent differences between childhood and adult learning. Young brains were relatively empty which permitted synapses to form readily yielding easy memorization. Conversely, adult brains filled with previous learning and experiences resulted in a need to share pathways. Adults had difficulty with rote memorization because they must find rare unused synapses to store new information. Hence, adults sought similar known facts with which to form a relationship between new and existing data in order to achieve retention and recall ("A neural network," 1998). Furthermore, new

synapses formed easily but breaking down stable synapses required a great deal of energy. Thus, unbinding old information (i.e. relearning or unlearning) was much more difficult than learning new information (Learnativity, 1999). This explained why rote memorization worked well for children, but for adults with congested pathways, learning took the form of integration and abstraction ("A neural network"). A look at language acquisition demonstrated this phenomenon.

McCandliss, Posner, and Givon (1997) developed an artificial language consisting of 68 words designed to demonstrate language acquisition. McCandliss et al. taught this 68-word language to a group of college students over the course of five weeks. Upon completion, the results of this experiment concurred with previous findings, which identified language acquisition loci within the brain. However, the study also indicated that adult readers could not easily modify the learning process. This was consistent with the behaviorists' belief that language acquisition was easier for children than adults, but only brain physiology could explain the phenomenon.

Brain mapping promised to contribute an answer to bridging the gap between behaviorists and lateralists. Through neuroimaging, brain-mapping studies established that

the entire brain participated in receiving, analyzing and processing input with specialized loci predominantly responsible for specific types of stimuli. More precisely, brain mapping applied to Luria's Model of Brain Functioning offered a vehicle for resolving the psychologists vs. lateralists debate (Languis & Miller, 1992).

Brain Mapping

Brain mapping encompassed diagnostic studies previously used to learn about fetal brain development, map localized pre-surgical brain functions, and study learning disorders such as dyslexia (Dryer et al., 1999; Languis, 1998). Two neuroimaging techniques, electroencephalograms (EEGs) and positron emission tomography (PET scans), demonstrated increased levels of activity associated with specific stimuli being focused in certain brain centers. In contrast, a high degree of association between the cerebrum and midbrain was demonstrated by only mild activity in tomographic studies (Esler, 1984). The process of recording significant Event-Related Potentials (ERPs) identified focal areas for specific functions, such as language processing in the right parietal-occipital region (Bigler et al., 1998). ERPs constituted electrical brain responses to external stimuli recorded on an EEG. PET scans recorded neural activity by monitoring blood flow following the injection of

a radioactive tracer into the blood stream. In contrast to electrical impulses identified as ERPs on EEGs, increased blood flow seen on PET scans was associated with increased neural activity (Smith & Jonides, 1997).

Another brain mapping application involving individuals with learning disorders provided clinical evidence of individual differences in processing visual and auditory stimuli lending support to the theory of learning style preferences. Adults who learned a second language in later life demonstrated a different language processing area than adults who spoke only one language (Languis, 1998). Not only did studies indicate different brain foci were specific to complex tasks, like naming objects or remembering music, studies also cataloged information processed differently by beginners and experts in a given discipline (Gardner, 1999). To understand this phenomenon, short-term and long-term memory warranted revisiting.

Edward Smith and John Jonides (1997) differentiated working memory neural pathways for object, spatial, and verbal memory tasks, and anticipated the discovery of other types of working memory. Short-term or "working" memory serves as the blackboard for reasoning, problem solving, and language understanding (Smith & Jonides). Another way of depicting short-term memory was as a fluid, lacking form and

stability (Prabhakaran et al., 1997). Stable long-term or crystallized knowledge was used to process fixed answer questions, whereas short-term or fluid memory reasoning was required for analysis and problem solving.

Evidence confirmed that both crystallized long-term memory, such as identification, and task-oriented working memory processes were domain specific, which resulted in laterally dominant activity. On the other hand, fluid reasoning required for problem solving and forming relationships between fundamentals, by nature, was not domain specific and resulted in whole brain involvement (Prabhakaran et al., 1997).

Specific functions, such as auditory, visual, reading, speaking, and facial recognition, occurred in dedicated loci of the brain. Nonetheless, even the smallest and simplest functions required the entire brain participate in concert under the direction of the midbrain (Esler, 1984). One study confirmed domain-specific working memory for visual, spatial and verbal task performance. Additionally, it authenticated that many domain-dependent and domain-independent loci were involved in critical thinking or problem-solving tasks within the working memory system. This study further established that to discriminate and form relationships required the ability to transcend hemispheric loci

(Prabhakaran's et al., 1997). A study by Smith and Jonides (1997) supported Prabhakaran et al. Smith and Jonides manipulated remembered verbal, visual, or spatial information using a variation on Sternberg's item-recognition paradigm. Their results revealed right lateralized spatial memory and left lateralized verbal/visual memory directed discrete tasks, but continuous tasks involved a greater degree of overlapping between hemispheres. Given the results of brain mapping, the ability of Luria's model for research in cognitive psychophysiology to reproduce empirically testable results became increasingly significant in bridging the gap between psychology and physiology (Languis & Miller, 1992).

Luria's Model

Marlin Languis and Daniel Miller (1992) provided an excellent discussion of Luria's model. Given the belief that the breach between cognitive science and classroom practice must be resolved before effective educational reform could be achieved, Languis and Miller suggested that Luria's dynamic theory offered a valid alternative to the traditional static cognitive models. So convincing was their argument it warranted a brief synopsis of their discussion of Luria's theory based on three functional units.

According to Languis and Miller (1992), Luria identified the three functional units as the arousal/attention unit, the sensory input/integration unit, and the executive planning/organization unit. These three units characterized individualized functions. First, the arousal/attention unit, comprised of the brainstem, regulated the tone of the waking mental state. This unit enabled the individual to maintain focus and attention by regulating cortical tone (arousal). Just as muscle tone was critical to muscle function, cortical tone was critical to thought processes. Without proper cortical tone, the other two units were unable to function effectively.

Secondly, the sensory input/integration unit consisted of the sensory and association areas in the cerebrum. Through both successive and simultaneous processing, the cerebrum received, analyzed, and stored information. Simultaneous processing equated with spatial or right brain functioning. Like deductive reasoning, it viewed the total picture as integrated elements. Successive coding resembled inductive reasoning. Located in the left brain, it was linear, sequentially organizing individual stimuli into serial order or relationships. Luria emphasized that all tasks involved both successive and simultaneous processing in the same way they involve right and left brain

integration although some individuals preferred one approach to the other.

Lastly, the executive planning/organizing unit was located in the frontal and prefrontal areas of both hemispheres. Not only did this unit program, regulate, and verify all activity, as the center of human intellect, it also allowed for higher thought processes like problem solving, impulse control, spontaneous speech, and voluntary actions. Therefore, an individuals' ability to plan, formulate new questions and self-monitor originated in the executive unit.

According to Languis and Miller (1992), Luria cautioned researchers from taking a strictly lateralist stance, stating that although specific parts of the nervous system were responsible for certain tasks, the brain functioned as a whole. All three units previously described were involved in any mental activity. The sensory unit received and directed stimuli to the arousal unit, which analyzed and stored the information upon which the executive unit acted. All three units were essential to effective cognitive functioning (Languis & Miller).

Brain mapping provided the instrument for definitive identification of each locus in Luria's model. Languis and Miller were able to verify Luria's three units by recording

ERPs during different tasks. Languis (1998) also reported that these results were verified by several Spatial Visualization Tests (SVT) performed during the 1980s and early 1990s. Languis further cited results from an additional study, which provided evidence that training could improve spatial visualization (Languis).

Bridging the Gap

Application of Luria's theory to the debate between psychologists and lateralists offered hope to seal the breach between the two factions. According to Luria's theory, all mental activity resulted from task-specific brain loci acting in concert much like the individual instruments in an orchestra worked collectively to create a symphony (Languis & Miller, 1992). Brain mapping also supported Spoon and Schell (1998) who felt a single instructional technique was ineffective for different types of tasks or all types of students. Evidence further implied that learning success was enhanced measurably when strategies accommodating learning style preferences were made available during a given task (Languis, 1998).

Posner (1997) connoted that identifying cognitive loci was irrelevant to theoretical questions posed by cognitive psychology. It was Posner's hope that brain mapping would generate interaction between lateralists and cognitive

psychologists as mysteries of the human mind unfolded. In support of integration, Holyoak (1997) adopted Von Clausewitz's concept that cognitive neuroscience and cognitive psychology resembled the relationship between war and politics. Holyoak also believed the proposed gap would narrow as neuroimaging provided more understanding of cognition. Unfortunately, not all researchers accepted brain-mapping conclusions.

In 1999, Bruer identified categorical spatial reasoning as left loci and coordinate spatial reasoning as right loci. Bruer submitted this as proof that spatial reasoning was not right brain discrete in an attempt to debunk a lateralist interpretation of brain mapping. However, Bruer contradicted himself by citing lateralist research, which indicated that the brain processed tasks in parts and wholes simultaneously. More precisely, dedicated hemisphere processing of categorical and coordinate reasoning, regardless of the nature of the stimuli, was consistent with Luria's model of discrete loci acting cooperatively. Languis and Miller (1992) offered the following example of how discrete brain loci integrated structure to achieve function:

- The brainstem allowed the individual to focus attention.

- Wernicke's area received, encoded, and sorted input.
- Successive activity (left hemisphere) provided sequential processing to create order.
- Simultaneous activity (spatial or right hemisphere) integrated the parts to form a whole concept.
- Frontal and prefrontal areas analyzed the input to develop plans, ask questions, and solve problems.

Note that successive and simultaneous processing transpired concurrently. Simultaneous and successive, or deductive versus inductive, processing occurs in all individuals, but a preference for one over the other lead to a preferred learning style. Luria's theory supported the findings of different cognitive processing preferences by individual learners (Languis & Miller, 1992). Accordingly, it became important to accommodate preferred learning styles while helping individual students develop skill in the other domains (Sonnier, 1985).

A physiologically based model of memory processing (PBMMP) founded upon the concept of neural clusters lent efficacy to many of psychology's experimental principles such as the use of multisensory input to increase conceptualization and recollection of data (Esler, 1984). Adult learners increased the ease with which neural pathways

formed by adopting strategies that generated relationships between previous and new information through variety and pattern formation. Any neural network, especially in adults, memorized a relatively small amount of data. Therefore, abstraction, a higher learning strategy that linked facts together in meaningful ways, was necessary to achieve learning ("A neural network," 1998).

Summary

In spite of the debate between behavioral psychologists and lateralists, evidence attested that both sides vindicated the validity of accommodating learning styles in the educational process (Bruer, 1999; Dryer et al., 1999; Esler, 1984; McKeachie, 1995). The relationship between brain processing and task performance offered two educational interventions to facilitate student success:

- Changes made in curricula and presentation methodology to incorporate learning styles and
- Strategies adopted by the learners in their approach to cognitive skills to accommodate preferred learning styles (Languis, 1998).

Accommodating learning preferences was not a panacea for society's educational problems, however, if combined with traditional theory and methodology, learning preference accommodation increased the chance of success (Guild &

Chock-Eng, 1998). Adults who found it difficult to memorize large quantities of new facts required alternatives to rote memorization and traditional instruction ("A neural network," 1998). Successful modern students assumed responsibility for meeting their own needs and demanded that educators do the same. This required that the student also understood the learning process, thereby applying metacognitive strategies (Learnativity, 1999).

Without resolution among the many educational factions, adult learners needed the tools to take ownership of their education. The most important thing learners could do was to identify their learning style and choose strategies to accommodate that preference (Learnativity, 1999). This text's goal was to provide the adult learners with self-assessment instruments and suggested strategies to accommodate their preferred method of learning.

CHAPTER THREE

Methodology

Introduction

Chapter Three detailed the background and history leading to the generation of this textbook proposal. It included a description of the population served and the project development. This chapter presented resources and content validation, outlined the project design, and concluded with a summary of the project methodology.

Population Served

Adult learners in postsecondary vocational education were the target population. Although directed toward a proprietary educational arena, the project generalized to include adult learners in traditional academic institutions as well. As established in Chapter Two, adult learners processed information differently than children. This textbook design promoted the success of adults in the pursuit of knowledge through identification and accommodation of their individual learning styles. The intent was to generate a textbook proposal for submission to a national publishing house in order to reach the greatest number of adult learners in the United States.

Project Development

An in-service workshop presented in 1990 at Skadron College in San Bernardino, California generated the initial interest in this topic. Methodologies outlined during that workshop provided the impetus to delve deeper into this fascinating area. From 1990 to present, continued investigation into learning styles resulted in gravitation toward the subject matter ultimately selected for this project. In an effort to ensure utilization of current research, formulation of the project outline employed both traditional and on-line resources.

Project Resources and Content Validation

Extensive traditional researches conducted and reported on in Chapter Two supported the validity of this project. A myriad of journal articles and books contributed the didactic information presented in the textbook proposal. However, continued research was essential upon acceptance of the proposal and development of the manuscript. Information on assessment and evaluation tools was derived from the World Wide Web. Both on-line and traditional resources appear in the appendices for the reader's reference. Through the identification of current trends and issues relevant to the adult learner, resources selected and cited throughout

the project appeared to fit seamlessly in support of the hypothesis formulated from the original workshop.

From 1990 through 1998, the instructor empirically applied workshop theory to students attending Skadron College by testing the available sample population for learning style preference, then counseling students on accommodation methodologies. During those eight years, the instructor of record noted a measurable improvement in academic performance, in some instances as much as two grade points. This informal observation resulted from the instructor implementing learning style theory to practical application in an isolated classroom environment. Although not a structured research project, students incorporating learning style preference into their study habits reported reduced time and effort spent for greater achievement, which served as the catalyst for this proposal. Resulting research reviewed in Chapter Two solidified the hypothesis and validated the project resources as well as the exigency of the textbook and its content.

Project Design

The project design lent itself to industry standards for a textbook proposal submission. Both traditional hard copy and electronic media were utilized to present a summary of this thesis, including a description of the target

audience and needs assessment. A review of existing competitive publications and sample chapters are in the offing contingent upon request of the publishing house.

The design of the textbook itself included a preface to condense and simplify the literature review and describe the background of the project. An introduction to the adult learner provided instructions on how to use the text and appendices. Following a table of contents, the initial chapter explained the concepts relating to learning styles, multiple intelligences, and metacognition. Subsequent chapters addressed individual learning preferences in depth and provided methodologies and strategies for accommodating each. Throughout, the text outline emphasized the importance of assessing and accommodating learning styles and related theory to the individual's academic success.

Planned appendices presented various assessment tools contingent upon permission from the copyright owner for reproduction. In order to provide a comprehensive resource for the reader, separate appendices identified and referenced assessment tools for which permission for inclusion was not forthcoming, provided traditional resources, on-line citations, and books for additional student erudition.

Summary

When implemented, effective methodologies and strategies for accommodating individual learning preferences advanced the academic success of adult learners. However, most adult students were unaware of the existence of learning style preference and many educators failed to provide this information. The objective of this project was to put the power of learning style effectiveness into the hands of the greatest number of adult learners in order to facilitate their success. To accomplish this goal, upon completion this thesis/project plans for issuance included submissions to additional publishing houses and/or electronic publication on the World Wide Web.

CHAPTER FOUR

Conclusions and Recommendations

Introduction

Included in Chapter Four was a presentation of the conclusions and recommendations formulated during the project's development. Chapter Four concluded with a summary of findings.

Conclusions

Growth and development is an essential element in the human condition. For adults who have reached physical maturation, growth must reside with an expansion of the mind known as learning. However, the debate on how learning is achieved rages. The following conclusions were developed and extracted during the research process.

- Adults learned differently than children and required specific environmental factors to facilitate learning.
- Numerous learning style models facilitated the academic success of adult learners.
- Research suggested a low percentage of educators employed learning style preference in instructional methodology.
- Behavioral psychologists viewed metacognition from a mental functioning or "software" point of view whereas

lateralist/neuroscientists explored how brain structures or "mental hardware" processes information.

- During the latter part of the 20th century, research into brain physiology contributed to the understanding of how neural networks functioned on a physiological basis.
- Brain mapping identified the locus associated with specific tasks while demonstrating total brain involvement in all tasks.
- Luria's model of three functional units in the brain applied brain physiology and brain mapping to information processing.
- A vehicle for resolving the debate between lateralist and psychologists resided in research on brain physiology, brain mapping, and Luria's model.
- Academic success for the adult learner was facilitated by changes in curricula and presentation and by learner applied strategies to accommodate learning style preferences.

Recommendations

Resources reviewed in Chapter Two established three areas of concern. First, many adult educators, through either ignorance or neglect, failed in their responsibility

to provide every possible instrument to facilitate the academic success of their students. Second, adult learners had a responsibility to take ownership of their education and, as such, required the tools for success. Finally, continued research of this controversial subject was imminent both to provide better adult education and to seal the breach between educational factions. With these issues in mind, the following recommendations ensued:

- Information regarding metacognition, learning style preference, and multiple intelligences should be made readily available to adult learners.
- Adult learners should have access to learning style assessment tools and recommendations for methodologies and strategies to accommodate identified preferences.
- Continue brain-mapping research to further study information processing and gain a more decisive understanding of the learning process.
- Continue research and study to seal the breach between behavioral psychologists and lateralist neuroscientists.
- Continue research to increase the understanding and validity of learning styles.

Summary

Reported research revealed that the majority of educators were not knowledgeable of learning styles or were unwilling to adopt strategies to accommodate individual preferences in instructional methodologies. In the absence of effective instruction, providing adult learners with self-assessment tools and practices empowered them to achieve academic success. This project will put the information and tools into the hands of the adult learner in a vocational arena.

Should educators also review this project, it would only improve the degree of academic success of adult learners. Overall, the intent of the project was to enable the adult learner to receive additional benefits from the presentation of existing curricula in the post secondary educational arena.

Appendix A

Figures

Figure 1 Three Phases of Kuhn's Paradigm Change Model
Gehring (1999)

	CHAOS ⟹	NORMAL SCIENCE ⟹	EXTRAORDINARY SCIENCE ⟹	NEW PARADIGM
	Occurs only once	A paradigm, ushered in by a "hero," begins a puzzle-solving period	Crisis leads to revolution	Brings with it a new period of normal science
The Role of a Well Socialized Member of the Processional Community	Categorize data, to make some sense of a mysterious world. Chaos ends when the community installs the first paradigm.	Receive the paradigm (experience initiation--attend school to become authorized as a community member, read texts written on the paradigm, learn its exemplars/rules); use the paradigm to solve the puzzled of your profession; ignore puzzles that "can not" be solved (anomalies).	Ignore the anomalies for as long as possible, then "adjust" the paradigm to accommodate as many anomalies as possible; when they can not longer be ignored, "admit" that a state of crisis may exist in the profession; when the paradigmatic rules no longer work (puzzles can no longer be solved), grasp urgently to any theory that may solve the most important anomalies, and thus become the new paradigm.	Yesterday's extraordinary science becomes tomorrow's new Normal Science
Advantages	Categorized data may lead to a paradigm.	Normal science is an excellent, effective strategy for solving relevant puzzles.	Extraordinary science draws out the creativity and resourcefulness of poorly socialized professionals.	Potential win/win situation
Disadvantages	Chaos is a phase of limited growth, when few puzzles can be solved.	Normal science professionals can not predict a future that diverges from what they know; socialization inhibits their seeing "the big picture or anything without the paradigm.	In times of extraordinary science, professional must be 'superhuman" to succeed at the workplace; the high anxiety that characterizes extraordinary science exacerbates all work related problems.	

Figure 2

David Kolb's Learning Style Grid

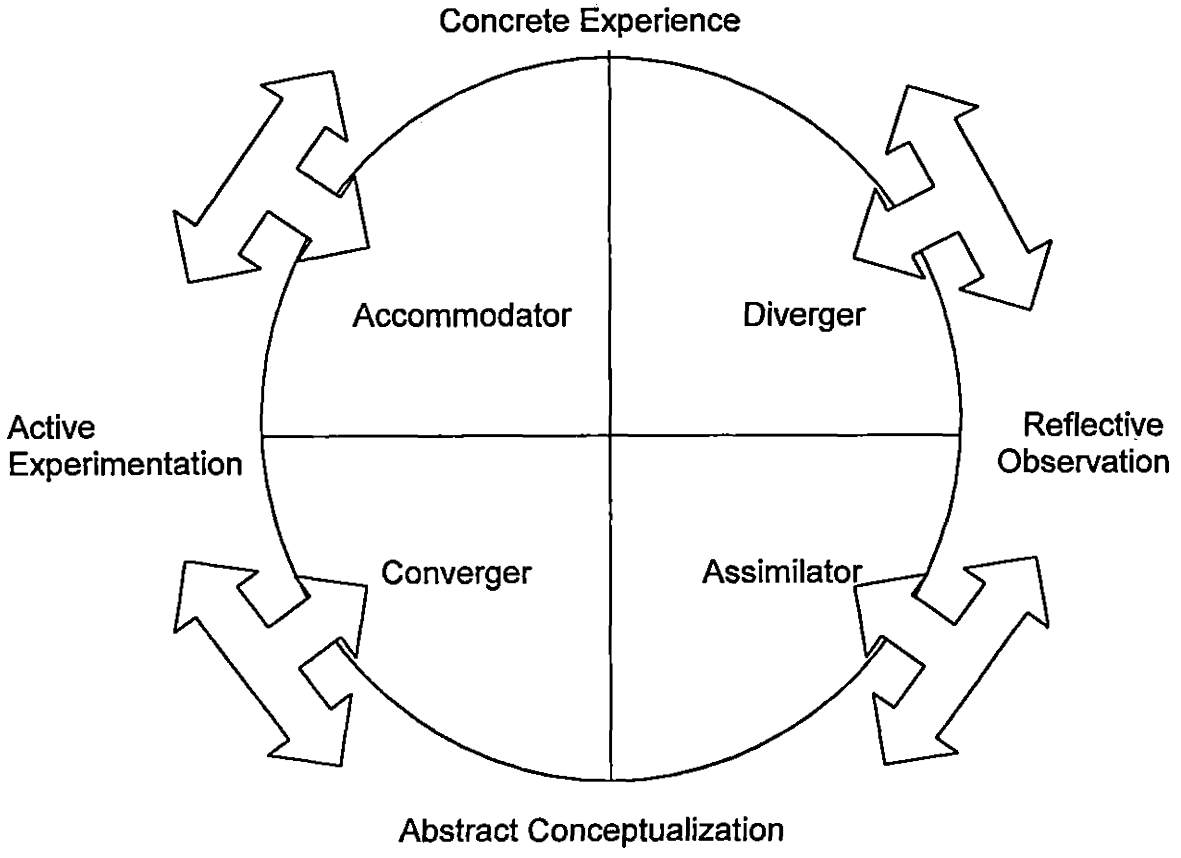
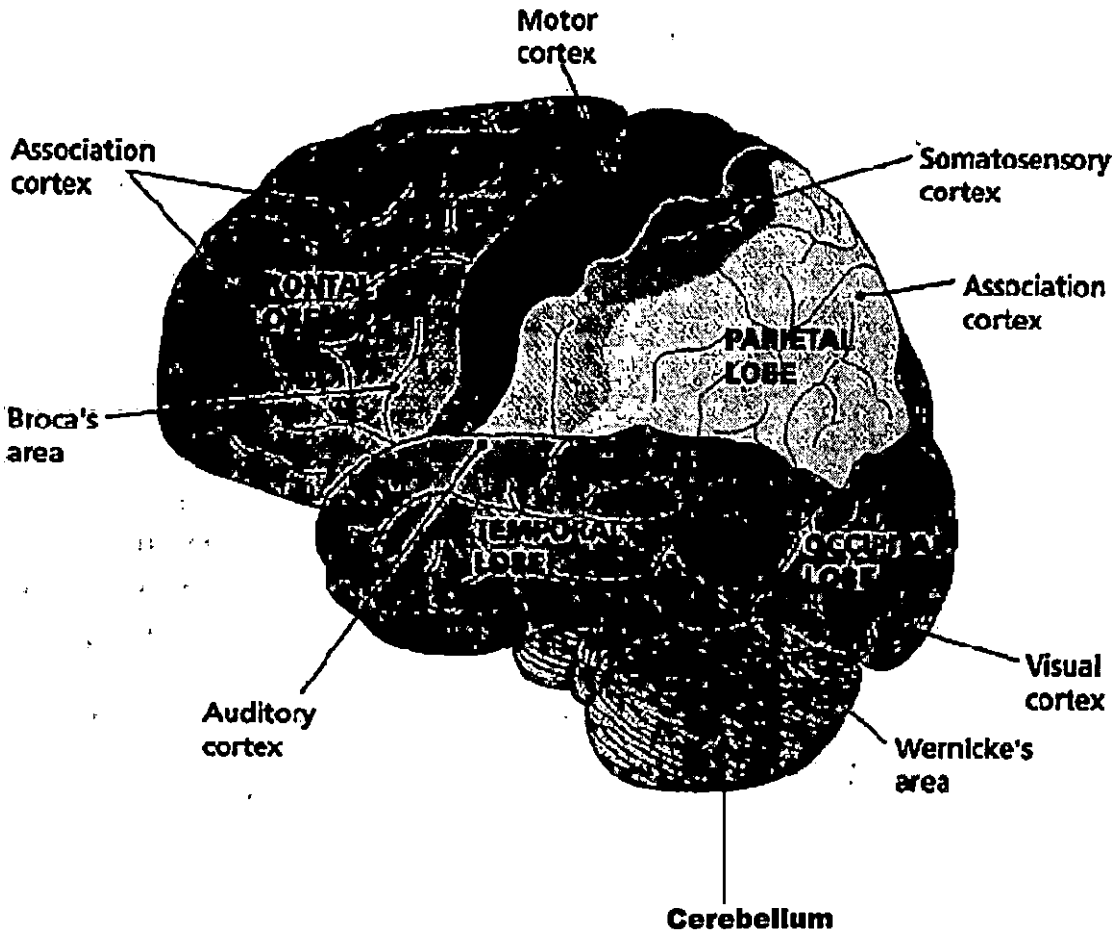


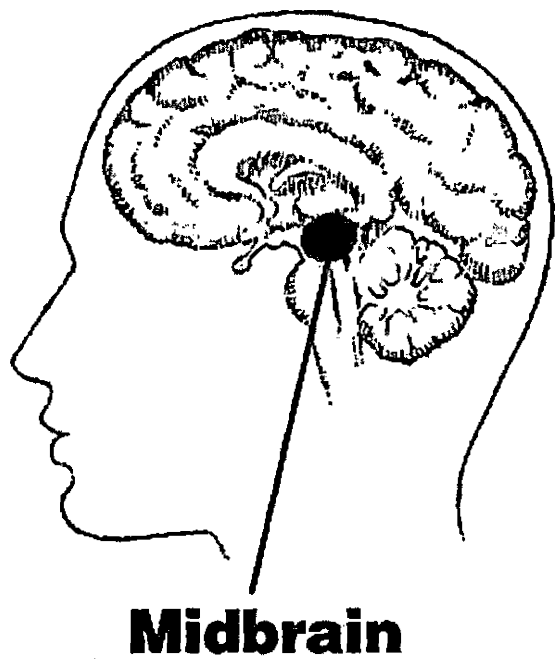
Figure 3

Diagram of the Brain



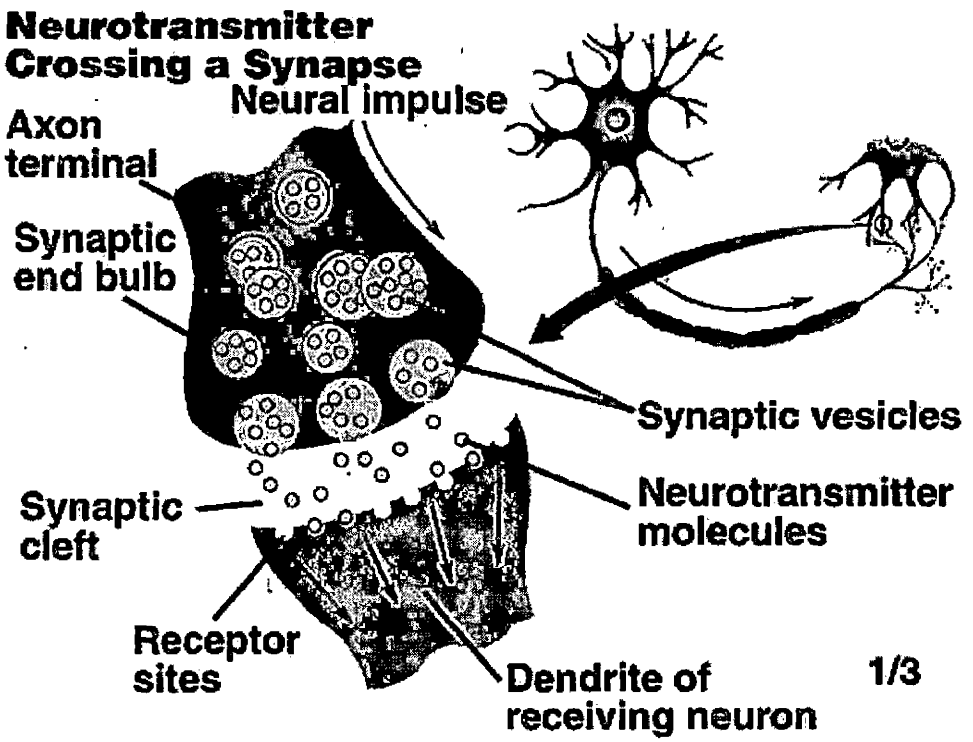
Available FTP:
http://psych.wisc.edu/faculty/pages/croberts/catonpic/topicr/cortex2.gif

Figure 4
Midbrain



Psychology Online - Visuals. Available FTP: http://longman.awl.com/zimbardo2e/visuals_4.asp

Figure 5
Neurotransmission Across a Synapse



Psychology Online - Visuals. Available FTP: http://longman.awl.com/zimbardo2e/visuals_4.asp

Project

LEARNING STYLES: A STUDENT GUIDE

TO SELF-ASSESSMENT AND ACCOMMODATION

This appendix presents an outline for the textbook proposal. All components, but not the full content, of the text are included. The following outline represents the style and ambiance conceived for the book at the reading level for the target audience of adult learners. It provides a brief description of the content development during manuscript preparation. Generation of the full text was dependent upon acceptance for publication by a national publishing company. It was left to the publisher to request sample chapters.

Manuscripts tend to develop a life of their own, not excepting this document. Therefore, the table of contents and outline provide working guidelines, which are subject to revision and reorganization throughout the development of the manuscript. Considerations that influence manuscript development include but are not limited to available documentation, new or revised references, publisher's recommendations and editor's suggestions. Ultimately, clarity, value, and ease of use by the reader dictate the final product.

Preface

Directed toward educators and administrators of adult learners as well as the learners themselves, this preface includes a condensed lay interpretation of the literature review presented in Chapter Two. Content focuses on the project's background and a brief discussion of educational philosophies including a brief history and current trends and issues pertaining to learning styles as applied to adults. Technical and medical information is omitted except as deemed necessary for support or clarification included written in lay terms. The discussion focuses on those aspects that benefit adult learners and omits controversial debates between factions.

Introduction

This introduction addresses the adult learner. It will focuses on how to use the text and appendices for self-assessment and learning style accommodation.

Table of Contents

Strategies for visual/spatial learners

Strategies for musical learners

Strategies for bodily/kinesthetic learners

Strategies for interpersonal learners

Strategies for intrapersonal learners

Strategies for combination learners

What is my motivational style?

Am I activity-oriented?

Am I learning-oriented?

Motivational style strategies

How does personality and temperament affect learning?

What are assessment tools?

Types of assessment tools

Locating assessment tools

Using assessment tools

Putting it all together for academic success

Chapter 1

What is metacognition?

Chapter One opens with a discussion of metacognition and the importance of its impact on the adult learner. This introduction is limited to basic concepts serving as a foundation for more detailed discussions to follow.

How does learning occur?

Section One offers a simplified explanation of the physiological learning process described in the Chapter Two literature review.

What are learning styles?

This section provides a history and overview of learning style theory. Although a brief discussion of Kolb's quadrants establishes a foundation for learning style theory, the chapter focuses on the four currently recognized learning style preferences addressed in depth later in the publication.

What are multiple intelligences?

This section places emphasis on how Gardner's multiple intelligences theory interfaces with and compliments learning styles.

What are motivation styles?

A discussion of activity-oriented learners and learning-oriented learners applied to the adult is particularly applicable.

Chapter 2

Am I a visual learner?

This chapter opens with a brief overview of visual learners.

How does reading differ from visual learning?

This section discusses the traditional concept of the visual learner followed by Reinert's differentiation between reading learners, who prefer books, versus visual learners, who prefer pictorial representations like charts, diagrams and pictures. Reinert's concept is the basis for all subsequent discussions on strategies.

Characteristics of visual learners

General characteristics and habits of visual learners, such as looking toward the ceiling for answers, are discussed.

Strategies for visual learners

Strategies and methodologies for accommodating visual learners include independent study and in-class practices. For example, how can visual learners adapt their learning preference to activities such as taking notes in lecture, participating in laboratory exercises, and preparing for exams?

Chapter 3

Am I an auditory learner?

This chapter opens with a brief overview of auditory learners.

Characteristics of auditory learners

General characteristics and habits of auditory learners, such as reading test questions aloud, are discussed.

Strategies for auditory learners

Strategies and methodologies for accommodating auditory learners include independent study and in-class practices. For example, how can auditory learners adapt their learning preference to activities such as completing reading assignments, participating in laboratory exercises, and preparing for exams?

Chapter 4

Am I a kinesthetic learner?

This chapter opens with a brief overview of kinesthetic learners.

Characteristics of kinesthetic learners

General characteristics and habits of kinesthetic learners, such as fidgeting and doodling, are discussed.

Strategies for kinesthetic learners

Strategies and methodologies for accommodating kinesthetic learners include independent study and in-class practices. For example, how can kinesthetic learners adapt their learning preference to activities such as completing reading assignments and preparing for exams?

Chapter 5

Am I a combination learner?

This chapter opens with a brief overview of combination learners.

Combining strategies for combination learners

Most learners are combination learners to varying degrees. Strategies and methodologies for accommodating combination learners include independent study and in-class practices. For example, how can auditory/kinesthetic learners adapt their learning preference to activities such as completing reading assignments and preparing for exams? Can I improve in my weak areas?

Reinforcement through combined study techniques improves "at risk" learning styles. This section discusses how to augment and improve weak learning styles by using all five senses and combining learning strategies.

Chapter 6

What are my intelligences?

This chapter opens with a brief overview of multiple intelligences theory and its relationship to learning styles.

Strategies for verbal/linguistic learners

General characteristics and habits of verbal/linguistic learners, such as enjoying word games, are discussed. Strategies and methodologies for accommodating verbal/linguistic learners include independent study and in-class practices. For example, how can verbal/linguistic learners adapt their learning preference to skills based exercises and preparing for exams?

Strategies for logical/mathematical learners

General characteristics and habits of logical/mathematical learners, such as performing tasks in sequential order, are discussed. Strategies and methodologies for accommodating logical/mathematical learners include independent study and in-class practices. For example, how can logical/mathematical learners adapt their learning preference to activities such as taking notes in lecture and preparing for exams?

Strategies for visual/spatial learners

General characteristics and habits of visual/spatial learners, such as thinking in images, are discussed. Strategies and methodologies for accommodating visual/spatial learners include independent study and in-class practices. For example, how can visual/spatial learners adapt their learning preference to activities such as taking notes in lecture and preparing for exams?

Strategies for musical/rhythmic learners

General characteristics and habits of musical/rhythmic learners, such as listening to music while studying, are discussed. Strategies and methodologies for accommodating musical/rhythmic learners include independent study and in-class practices. For example, how can musical/rhythmic learners adapt their learning preference to activities such as workgroup activities and preparing for exams?

Strategies for bodily/kinesthetic learners

General characteristics and habits of bodily/kinesthetic learners, such as working well with their hands, are discussed. Strategies and methodologies for accommodating bodily/kinesthetic learners include independent study and in-class practices. For example, how can bodily/kinesthetic learners adapt their learning

preference to activities such as reading assignments and preparing for exams?

Strategies for interpersonal learners

General characteristics and habits of interpersonal learners, such as enjoying social activities, are discussed. Strategies and methodologies for accommodating interpersonal learners include independent study and in-class practices. For example, how can interpersonal learners adapt their learning preference to activities such as taking notes in lecture and preparing for exams?

Strategies for intrapersonal learners

General characteristics and habits of intrapersonal learners, a preference for being alone, are discussed. Strategies and methodologies for accommodating intrapersonal learners include independent study and in-class practices. For example, how can intrapersonal learners adapt their learning preference to activities such as participating in workgroups and preparing for exams?

Strategies for combination learners

As with learning styles, most learners demonstrate varying degrees of multiple intelligences. Strategies and methodologies for accommodating combination learners include independent study and in-class practices. For example, how can musical/linguistic learners adapt their learning

preference to activities such as completing reading assignments and preparing for exams?

Chapter 7

What is my motivational style?

This chapter opens with a brief overview of motivational styles.

Am I activity-oriented?

Emphasis of this topic focuses on adult learners who re-enter the educational arena as a result of an external impetus such as employment mandates or promotional goals.

Am I learning-oriented?

This section addresses adult learners re-entering the educational arena motivated by a personal desire for knowledge.

Motivational style strategies

This discussion of how to best benefit from the educational experience based on motivational styles is especially applicable to the adult learner.

Chapter 8

How does personality and temperament affect learning?

A discussion of the impact of individual personality types on learning references such instruments as the Myers-Briggs Type Indicator (MBTI) and the Keirsy Temperament Sorter, among others.

Chapter 9

What are assessment tools?

This chapter opens with an introduction to assessment concepts.

Types of assessment tools

A brief discussion presents the merits and demerits of self-assessment, proctored, and on-line assessment instruments.

Locating assessment tools

Referencing to appendices B and C, methods and resources for locating additional assessment tools are discussed.

Using assessment tools

Guidelines for using self-assessment instruments are outlined. Readers are apprised of practices that could invalidate results. Suggestions for interpreting results are presented.

Chapter 10

Putting it all together for academic success

This chapter focuses on synthesis of previous chapters. Emphasis focuses on the adult learners' responsibility to assume ownership of their educational experience. Guidelines for implementing the information in previous chapters focus on the necessity to tailor strategies and methodologies for individual effectiveness.

Self-Assessment and Evaluation Tools

Permission to reprint obtained from copyright owners of assessment and evaluation instruments dictated the content for this appendix. Continued research and permission is planned during the preparation of the final manuscript. This list is a representative sampling of the tools for which permission to reprint is being sought or purchased.

Evaluation Instruments

How does learning style influence homework? (1995). St. John's University's Center for the study of learning and teaching styles. [Homework disc developed for IBM and Apple software packages].

Learning Styles Inventory (LSI). (1995). Price Systems. Lawrence, KA. [Available on Apple and IBM self-scoring discs].

Reinert, H. (1986). Learning style identification exercise [Reproduced in *Becoming a master student,* see Ellis, 1991]. Edmonds School District No. 15 at Lynnwood, WA.

On-Line Self-Assessment and Evaluation Tools

Consistent with the constant fluctuation of World Wide Web sites, this partial list requires continual monitoring, research and updating throughout the development of the manuscript. This list represents a sampling of the final product.

On-Line Evaluations Instruments

NOTE: Theses tests are intended as general indicators, not for making major life decisions. The author does not endorse these tests.

Indiana State University. (1999). On-line inventories of learning styles. CTL learning styles site. Available FTP: http://web.indstate.edu/ctl/styles/invent.html.

Learning styles inventories. (1999). Available FTP: http://www.ccacc.cc.pa.us/webstudy/behsci/lstests.htm/

Murphy-Judy, Kathryn. (1995). Learning modalities, styles and strategies. [On-line article]. Virginia Commonwealth University, Foreign Language Department. Available FTP: http://www.fln.vcu.edu/intensive/LearningStrategies.html

On-Line References for Additional Reading

This list represents the type of additional on-line resources for additional reading and is subject to expansion during manuscript development.

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This planned appendix includes books and articles for the adult learner's additional reading and is subject to expansion during manuscript development.

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Glossary of Terms

This glossary represents a sample of terms included in the textbook and is subject to expansion during manuscript development.

Definition of Terms

Accommodators: A person who uses experience experimentation to learn.

Affective domain: Learning from emotions, feelings, attitudes, and values.

Assimilators: A person who uses observation and concepts to learn.

Auditory learner: Learner who prefers spoken instructions and oral information like lectures.

Bodily/kinesthetic: Intelligence that learns through and excels at physical activities.

Cognitive domain: Learning through trial-and-error and thinking about information.

Convergers: A person who learns through concepts and experimentation.

Critical [directed] thinking: Applying cognitive skills or strategies that will increase the probability of success.

Deductive reasoning: Forming conclusions by breaking the whole into its parts.

Divergers: A person who learns through observation and experience.

Inductive reasoning: Formulating a conclusion or hypothesis from a collection of observations.

Intelligence: Forming conclusions about the whole by looking at its parts.

Interpersonal: Intelligence that demonstrates an understanding of people and relationships with a preference for working in groups.

Intrapersonal: Intelligence that relies on emotion to understand oneself and others with a preference for working independently.

Learning styles: The method in which new information is collected, processed, internalized and retained.

Logical/mathematical: Intelligence that uses reasoning, patterns, and order to process information.

Metacognition: Knowledge and understanding about, how learning occurs.

Multiple intelligences: Approach to processing information identified as musical/rhythmic, bodily/kinesthetic, logical/mathematical, verbal/linguistic, visual/spatial, interpersonal and intrapersonal.

Musical/rhythmic: Intelligence that uses patterns such as pitch, melody, rhythm, and tone to process information.

Psychomotor domain: Learning through activities to complete a given task.

Tactile [kinesthetic] learner: Learner who uses activities that offer hands-on practice.

Verbal/linguistic: Intelligence that prefers spoken words.

Visual learner: 1) Learner who converts information into images and prefers written material. 2) Learner who prefers images, such as graphs, charts, diagrams, and pictures.

Visual/spatial: Intelligence that attempts accurately to visualize information.

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