THE KOLB LEARNING STLE INVENTORY

Versions 3.1 & 3.2

2013 TECHNICAL SPECIFICATIONS

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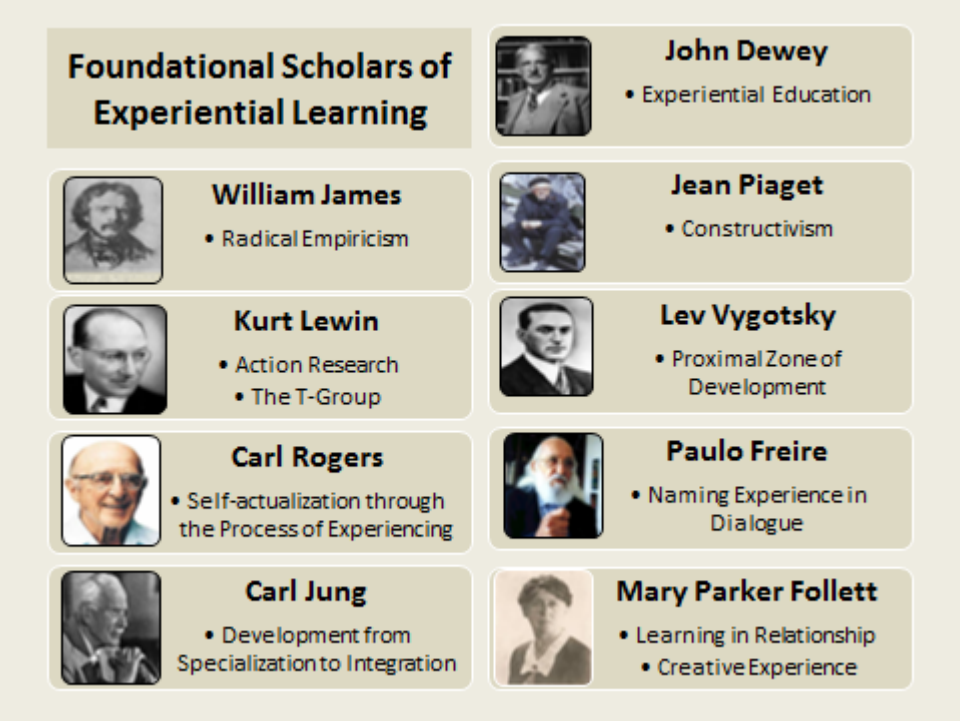
Abstract

The Kolb Learning Style Inventory version 3.1 (KLSI 3.1) revised in 2005 and the KLSI 3.2 revised in 2013 are updated revisions of the paper version of the original Learning Style Inventory developed by David A. Kolb. Like their predecessors, the KLSI 3.1 & 3.2 are based on experiential learning theory (Kolb 1984) and are designed to help individuals identify the way they learn from experience. The KLSI 3.1 & 3.2 norms are based on a larger, more diverse and representative sample of 6977 LSI users. The format, items, scoring and interpretative booklet remain identical with KLSI 3. The technical specifications are designed to adhere to the standards for educational and psychological testing developed by the American Educational Research Association, the American Psychological Association, and the National Council on Measurement in Education (1999). The first section of the technical specifications describes the conceptual foundations of the LSI in the theory of experiential learning (ELT). Section two provides a description of the inventory that includes its purpose, history, and format. Section three describes the characteristics of the KLSI 3.1& 3.2 normative sample. Section 4 includes internal reliability and test-retest reliability studies of the inventory. Section 5 provides information about research on the internal and external validity for the instrument. Internal validity studies of the structure of the KLSI 3.1 & 3.2 using correlation and factor analysis are reported. External validity includes research on demographics, educational specialization, and concurrent validity with other experiential learning assessment instruments, aptitude test performance, academic performance, experiential learning in teams, and educational applications.

1. EXPERIENTIAL LEARNING THEORY AND INDIVIDUAL LEARNING STYLES

The Kolb Learning Style Inventory differs from other tests of learning style and personality used in education by being based on a comprehensive theory of learning and development. Experiential Learning Theory (ELT) draws on the work of prominent 20th century scholars who gave experience a central role in their theories of human learning and development—notably John Dewey, Kurt Lewin, Jean Piaget, Lev Vygotsky, William James, Carl Jung, Paulo Freire, Carl Rogers and Mary Parker Follett—to develop a holistic model of the experiential learning process and a multi-dimensional model of adult development (Figure 1.)

Figure 1.



The theory, described in detail in *Experiential Learning: Experience as the Source of Learning and Development* (Kolb 1984), is built on six propositions that are shared by these scholars.

1. *Learning is best conceived as a process, not in terms of outcomes.* Although punctuated by knowledge milestones, learning does not end at an outcome, nor is it always evidenced in performance. Rather, learning occurs through the course of connected experiences in which knowledge is modified and re-formed. To improve learning in higher education, the primary focus should be on engaging students in a process that best enhances their learning – a process that includes feedback on the effectiveness of their learning efforts. "…education must be conceived as a continuing reconstruction of experience: … the process and goal of education are one and the same thing." (Dewey 1897: 79)

2. *All learning is re-learning.* Learning is best facilitated by a process that draws out the students' beliefs and ideas about a topic so that they can be examined, tested and integrated with new, more refined ideas. Piaget called this proposition constructivism—individuals construct their knowledge of the world based on their experience and learn from experiences that lead them to realize how new information conflicts with their prior experience and belief.

3. *Learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world.* Conflict, differences, and disagreement are what drive the learning process. These tensions are resolved in iterations of movement back and forth between opposing modes of reflection and action and feeling and thinking.

4. *Learning is a holistic process of adaptation to the world.* Learning is not just the result of cognition but involves the integrated functioning of the total person—thinking, feeling, perceiving and behaving. It encompasses other specialized models of adaptation from the scientific method to problem solving, decision making and creativity.

5. *Learning results from synergetic transactions between the person and the environment.* In Piaget's terms, learning occurs through equilibration of the dialectic processes of assimilating new experiences into existing concepts and accommodating existing concepts to new experience. Following Lewin's famous formula that behavior is a function of the person and the environment, ELT holds that learning is influenced by characteristics of the learner and the learning space.

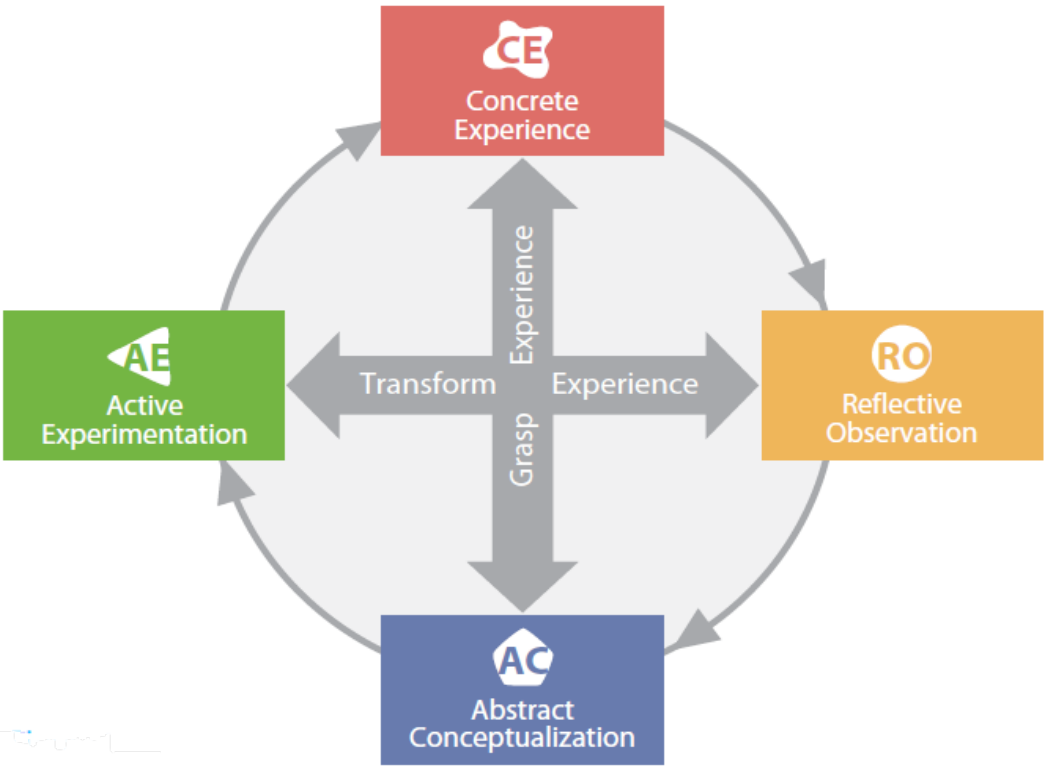
6. *Learning is the process of creating knowledge.* In ELT, knowledge is viewed as the transaction between two forms of knowledge: social knowledge, which is co-constructed in a socio-historical context, and personal knowledge, the subjective experience of the learner. This conceptualization of knowledge stands in contrast to that of the "transmission" model of education in which pre-existing, fixed ideas are transmitted to the learner. ELT proposes a constructivist theory of learning whereby social knowledge is created and recreated in the personal knowledge of the learner.

THE CYCLE OF EXPERIENTIAL LEARNING

ELT is a dynamic view of learning based on a learning cycle driven by the resolution of the dual dialectics of action/reflection and experience/abstraction. Learning is defined as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience." (Kolb, 1984, p. 41). Grasping experience refers to the process of taking in information, and transforming experience is how individuals interpret and act on that information. The ELT model portrays two dialectically related modes of grasping experience—Concrete Experience (CE) and Abstract Conceptualization (AC)—and two dialectically related modes of

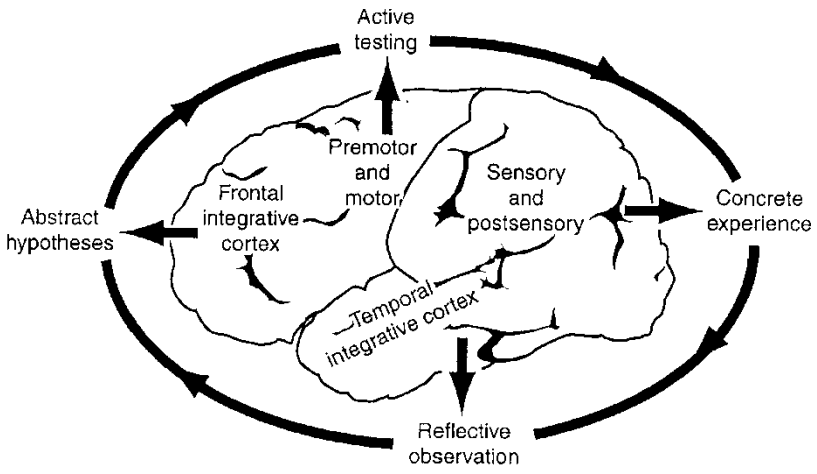
transforming experience—Reflective Observation (RO) and Active Experimentation (AE). Learning arises from the resolution of creative tension among these four learning modes. This process is portrayed as an idealized learning cycle or spiral where the learner "touches all the bases"—experiencing (CE), reflecting (RO), thinking (AC), and acting (AE)—in a recursive process that is sensitive to the learning situation and what is being learned. Immediate or concrete experiences are the basis for observations and reflections. These reflections are assimilated and distilled into abstract concepts from which new implications for action can be drawn. These implications can be actively tested and serve as guides in creating new experiences (Figure 2).

Figure 2. The Experiential Learning Cycle



In *The art of changing the brain: Enriching teaching by exploring the biology of learning*, James Zull a biologist and founding director of CWRU's University Center for Innovation in Teaching and Education (UCITE) sees a link between ELT and neuroscience research, suggesting that this process of experiential learning is related to the process of brain functioning as shown in Figure 2. "Put into words, the figure illustrates that concrete experiences come through the sensory cortex, reflective observation involves the integrative cortex at the back, creating new abstract concepts occurs in the frontal integrative cortex, and active testing involves the motor brain. In other words, the learning cycle arises from the structure of the brain." (Zull 2002: 18-19; 2011)

Figure 3. The Experiential Learning Cycle and Regions of the Cerebral Cortex.



Reprinted with permission of the author (Zull 2002)

LEARNING STYLE

Learning style describes the unique ways individuals spiral through the learning cycle based on their preference for the four different learning modes—CE, RO, AC, & AE. Because of one's genetic makeup, particular life experiences, and the demands of the present environment, a preferred way of choosing among these four learning modes is developed. The conflict between being concrete or abstract and between being active or reflective is resolved in patterned, characteristic ways. Much of the research on ELT has focused on the concept of learning style using the Kolb Learning Style Inventory (KLSI) to assess individual learning styles (Kolb & Kolb 2005b). In the KLSI a person's learning style is defined by their unique combination of preferences for the four learning modes defining a "kite" shape profile of their relative preference for the four phases of the learning cycle. Because each person's learning style is unique, everyone's kite shape is a little different.

ELT posits that learning style is not a fixed psychological trait but a dynamic state resulting from synergistic transactions between the person and the environment. This dynamic state arises from an individual's preferential resolution of the dual dialectics of experiencing/conceptualizing and acting/reflecting. "The stability and endurance of these states in individuals comes not solely from fixed genetic qualities or characteristics of human beings: nor, for that matter, does it come from the stable fixed demands of environmental circumstances. Rather, stable and enduring patterns of human individuality arise from consistent patterns of transaction between the individual and his or her environment…The way we process the possibilities of each new emerging event determines the range of choices and decisions we see. The choices and decisions we make to some extent determine the events we live through, and these events influence our future choices. Thus, people create

themselves through the choice of the actual occasions that they live through" (Kolb, 1984, p. 63-64).

Previous research with KLSI versions 1-3.1 has identified four learning style groupings of similar kite shapes that are associated with different approaches to learning — Diverging, Assimilating, Converging, and Accommodating. This research has shown that learning styles are influenced by culture, personality type, educational specialization, career choice, and current job role and tasks (Kolb & Kolb, 2013; Kolb, 1984). These patterns of behavior associated with the four basic learning styles are shaped by transactions between persons and their environment at five different levels—personality, educational specialization, professional career, current job role, and adaptive competencies. While some have interpreted learning style as a personality variable (Garner 2000, Furnam, Jackson & Miller 1999), ELT defines learning style as a social psychological concept that is only partially determined by personality. Personality exerts a small but pervasive influence in nearly all situations; but at the other levels learning style is influenced by increasingly specific environmental demands of educational specialization, career, job, and tasks skills. Table 1 summarizes previous research that has identified how learning styles are determined at these various levels.

Table 1
Relationship Between Learning Styles and Five Levels of Behavior.

Behavior level	Diverging	Assimilating	Converging	Accommodating
Personality types	Introverted Feeling	Introverted Intuition	Extraverted Thinking	Extraverted Sensation
Educational specialization	Arts, English History Psychology	Mathematics Physical Science	Engineering Medicine	Education Communication Nursing
Professional career	Social service Arts	Sciences Research Information	Engineering Medicine Technology	Sales Social service Education
Current jobs	Personal jobs	Information jobs	Technical jobs	Executive jobs
Adaptive competencies	Valuing skills	Thinking skills	Decision skills	Action skills

Personality Types.

Although the learning styles of and learning modes proposed by ELT are derived from the works of Dewey, Lewin and Piaget many have noted the similarity of these concepts to Carl Jung's descriptions of individuals' preferred ways for adapting in the world. Several research studies relating the LSI with the Myers-Briggs Type Indicator (MBTI) indicate that Jung's Extraversion/Introversion dialectical dimension correlates with the Active/Reflective dialectic of ELT and the MBTI Feeling/Thinking dimension correlates with the LSI Concrete Experience/ Abstract Conceptualization dimension. The MBTI Sensing type is associated with the LSI Accommodating learning style and the MBTI Intuitive type with the LSI Assimilating style. MBTI Feeling types correspond to LSI Diverging learning styles and Thinking types to Converging styles. The above discussion implies that the Accommodating learning style is the Extraverted Sensing type, and the Converging style the Extraverted Thinking type. The Assimilating learning style corresponds to the Introverted Intuitive personality type and the Diverging style to the Introverted Feeling type. Myers (1962) descriptions of these MBTI types are very similar to the corresponding LSI learning styles as described by ELT (Kolb, 1984, pp: 83-85).

Educational Specialization.

Early educational experiences shape people's individual learning styles by instilling positive attitudes toward specific sets of learning skills and by teaching students how to learn. Although elementary education is generalized, there is an increasing process of specialization that begins in high school and becomes sharper during the college years. This specialization in the realms of social knowledge influences individuals' orientations toward learning, resulting in particular relations between learning styles and early training in an educational specialty or discipline. For example, people specializing in the arts, history, political science, English, and psychology tend to have Diverging learning styles, while those majoring in more abstract and applied areas like medicine and engineering have Converging learning styles. Individuals with Accommodating styles often have educational backgrounds in education, communication and nursing, and those with Assimilating styles in mathematics and physical sciences.

Professional Career.

A third set of factors that shape learning styles stems from professional careers. One's professional career choice not only exposes one to a specialized learning environment, but it also involves a commitment to a generic professional problem, such as social service, that requires a specialized adaptive orientation. In addition, one becomes a member of a reference group of peers who share a professional mentality, and a common set of values and beliefs about how one should behave professionally. This professional orientation shapes learning style through habits acquired in professional training and through the more immediate normative pressures involved in being a competent professional. Research over the years has shown that social service and arts careers attract people with a Diverging learning style. Professions in the sciences and

information or research have people with an Assimilating learning style. The Converging learning styles tends to be dominant among professionals in technology intensive fields like medicine and engineering. Finally, the Accommodating learning style characterizes people with careers in fields such as sales, social service and education.

Current Job Role.

The fourth level of factors influencing learning style is the person's current job role. The task demands and pressures of a job shape a person's adaptive orientation. Executive jobs, such as general management, that require a strong orientation to task accomplishment and decision making in uncertain emergent circumstances require an Accommodating learning style. Personal jobs, such as counseling and personnel administration, that require the establishment of personal relationships and effective communication with other people demand a Diverging learning style. Information jobs, such as planning and research, that require data gathering and analysis, as well as conceptual modeling, require an Assimilating learning style. Technical jobs, such as bench engineering and production that require technical and problem-solving skills require a convergent learning orientation.

Adaptive competencies.

The fifth and most immediate level of forces that shapes learning style is the specific task or problem the person is currently working on. Each task we face requires a corresponding set of skills for effective performance. The effective matching of task demands and personal skills results in an adaptive competence. The Accommodative learning style encompasses a set of competencies that can best be termed Acting skills: Leadership, Initiative, and Action. The Diverging learning style is associated with Valuing skills: Relationship, Helping others, and Sense-making. The Assimilating learning style is related to Thinking skills: Information-gathering, Information-analysis, and Theory building. Finally, the Converging learning style is associated with Decision skills like Quantitative Analysis, Use of Technology, and Goal-setting (Kolb, 1984).

The following summary of the four basic learning styles is based on both research and clinical observation of these patterns of KLSI scores (Kolb, 1984, Kolb & Kolb 2013).

An individual with diverging style has CE and RO as dominant learning abilities. People with this learning style are best at viewing concrete situations from many different points of view. It is labeled "Diverging" because a person with it performs better in situations that call for generation of ideas, such as a "brainstorming" session. People with a Diverging learning style have broad cultural interests and like to gather information. They are interested in people, tend to be imaginative and emotional, have broad cultural interests, and tend to specialize in the arts. In formal learning situations, people with the Diverging style prefer to work in groups, listening with an open mind and receiving personalized feedback.

An individual with an assimilating style has AC and RO as dominant learning abilities. People with this learning style are best at understanding a wide range of information and putting into concise, logical form. Individuals with an Assimilating style are less focused on people and more interested in ideas and abstract concepts. Generally, people with this style find it more important that a theory have logical soundness than practical value. The Assimilating learning style is important for effectiveness in information and science careers. In formal learning situations, people with this style prefer readings, lectures, exploring analytical models, and having time to think things through.

An individual with a converging style has AC and AE as dominant learning abilities. People with this learning style are best at finding practical uses for ideas and theories. They have the ability to solve problems and make decisions based on finding solutions to questions or problems. Individuals with a Converging learning style prefer to deal with technical tasks and problems rather than with social issues and interpersonal issues. These learning skills are important for effectiveness in specialist and technology careers. In formal learning situations, people with this style prefer to experiment with new ideas, simulations, laboratory assignments, and practical applications.

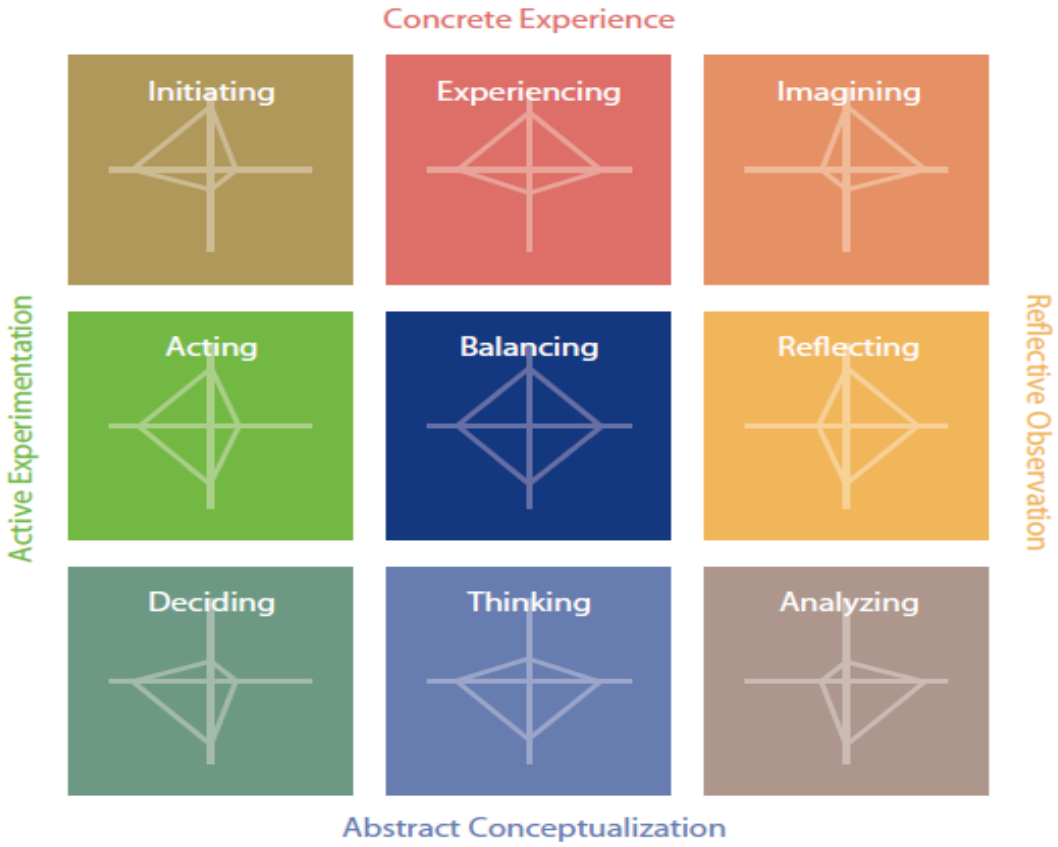
An individual with an accommodating style has CE and AE as dominant learning abilities. People with this learning style have the ability to learn from primarily "hands-on" experience. They enjoy carrying out plans and involving themselves in new and challenging experiences. Their tendency may be to act on "gut" feelings rather than on logical analysis. In solving problems, individuals with an Accommodating learning style rely more heavily on people for information than on their own technical analysis. This learning style is important for effectiveness in action-oriented careers such as marketing or sales. In formal learning situations, people with the Accommodating learning style prefer to work with others to get assignments done, to set goals, to do field work, and to test out different approaches to completing a project.

The nine learning styles of the KLSI 3.2

Data from empirical and clinical studies over the years has shown that these original four learning style types—Accommodating, Assimilating , Converging and Diverging— can be refined further into a nine style typology that better defines the unique patterns of individual learning styles and reduces the confusions introduced by borderline cases in the old 4 style typology (Eickmann, Kolb, & Kolb, 2004; Kolb & Kolb, 2005a&b; Boyatzis & Mainemelis, 2000). With feedback from users we first began noticing a fifth "balancing" style describing users who scored at the center of the Learning Style grid. Later we discovered that individuals who scored near the grid boundary lines also had distinctive styles. For example an "Experiencing" style was identified between the Accommodating and Diverging styles Four of these style types emphasize one of the four learning modes—Experiencing (CE), Reflecting (RO), Thinking (AC) and Acting (AE) (Abbey, Hunt & Weiser, 1985; Hunt, 1987). Four others represent style types that emphasize two learning modes, one from the grasping dimension and one from the transforming dimension of the ELT model—Imagining (CE & RO), Analyzing (AC & RO), Deciding (AC &AE) and Initiating (CE &AE). The final style type balances all four modes of the learning cycle—Balancing (CE, RO, AC &AE; Mainemelis, Boyatzis, & Kolb, 2002).

The KLSI 3.2 introduces these nine style types by moving from a 4 pixel to 9 pixel resolution of learning style types as described below. The learning style types can be systematically arranged on a two-dimensional learning space defined by Abstract Conceptualization-Concrete Experience and Active Experimentation-Reflective Observation. This space, including a description of the distinguishing kite shape of each style, is depicted in Figure 4. See Appendix 9 for detailed descriptions and case studies of the nine types.

Figure 4. The Nine Learning Styles in the KLSI 3.2



The **Initiating** style - initiating action to deal with experiences and situations. The Initiating style is characterized by the ability to initiate action in order to deal with experiences and situations. It involves active experimentation (AE) and concrete experience (CE).

The **Experiencing** style - finding meaning from deep involvement in experience. The Experiencing style is characterized by the ability to find meaning from deep involvement in experience. It draws on concrete experience (CE) while balancing active experimentation (AE) and reflective observation (RO).

The **Imagining** style - imagining possibilities by observing and reflecting on experiences. The Imagining style is characterized by the ability to imagine possibilities by observing and reflecting on experiences. It combines the learning steps of concrete experience (CE) and reflective observation (RO).

The **Reflecting** style - connecting experience and ideas through sustained reflection. The Reflecting style is characterized by the ability to connect experience and ideas through sustained reflection. It draws on reflective observation (RO) while balancing concrete experience (CE) and abstract conceptualization (AC).

The **Analyzing** style - integrating ideas into concise models and systems through reflection. The Analyzing style is characterized by the ability to integrate and systematize ideas through reflection. It combines reflective observation (RO) and abstract conceptualization (AC).

The **Thinking** style - disciplined involvement in abstract reasoning and logical reasoning. The Thinking style is characterized by the capacity for disciplined involvement in abstract and logical reasoning. It draws on abstract conceptualization (AC) while balancing active experimentation (AE) and reflective observation (RO).

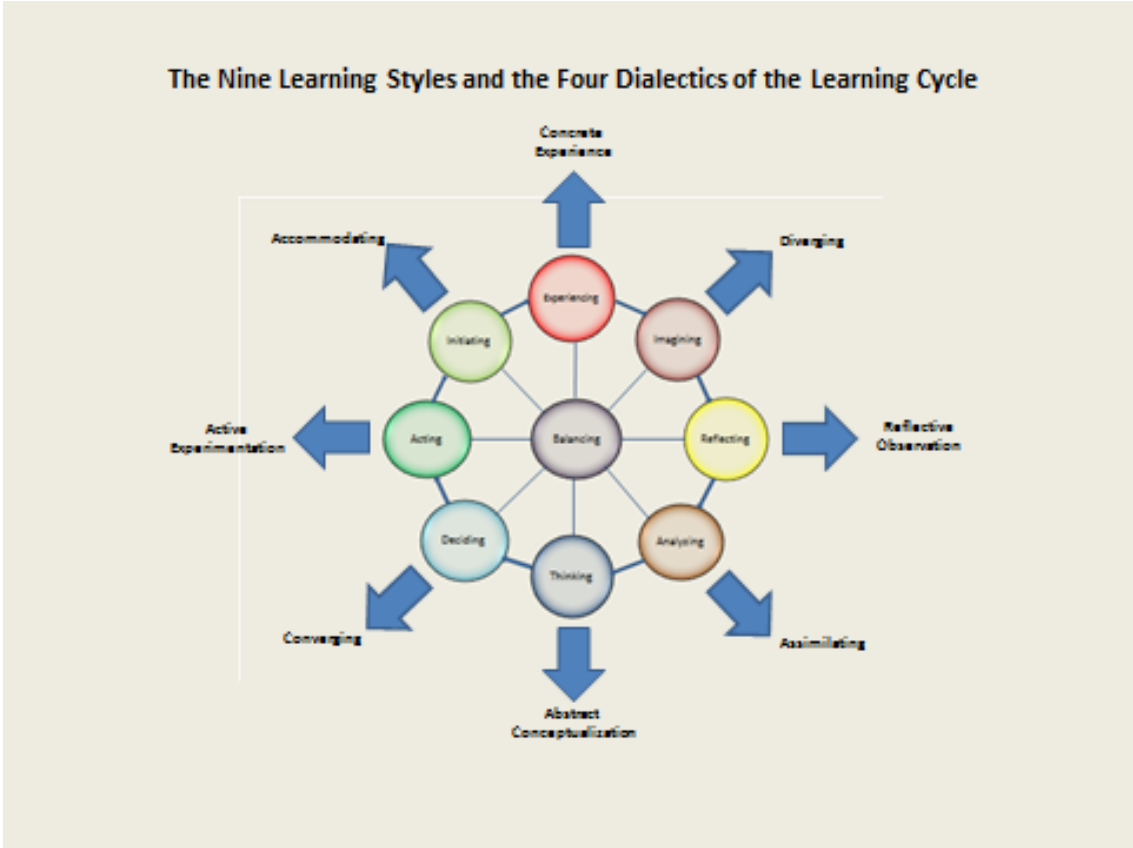
The **Deciding** style - using theories and models to decide on problem solutions and courses of action. The Deciding style is characterized by the ability to use theories and models to decide on problem solutions and courses of action. it combines abstract conceptualization (AC) and active experimentation (AE).

The **Acting** style - a strong motivation for goal directed action that integrates people and tasks. The Acting style is characterized by a strong motivation for goal directed action that integrates people and tasks. It draws on active experimentation (AE) while balancing concrete experience (CE) and abstract conceptualization (AC).

The **Balancing** style - adapting by weighing the pros and cons of acting versus reflecting and experiencing versus thinking. The Balancing style is characterized by the ability to adapt; weighing the pros and cons of acting versus reflecting and experiencing versus thinking. It balances concrete experience, abstract conceptualization, active experimentation and reflective observation.

These nine KLSI 3.2 learning styles further define the experiential learning cycle by emphasizing four dialectic tensions in the learning process. In addition to the primary dialectics of Abstract Conceptualization/Concrete Experience and Active Experimentation/Reflective Observation, The combination dialectics of Assimilation/Accommodation and Converging/Diverging are also represented in an eight stage learning cycle with Balancing in the center. Thus The Initiating style has a strong preference for active learning in context (Accommodation) while the Analyzing style has a strong preference for reflective conceptual learning (Assimilation). The Imagining style has a strong preference for opening alternatives and perspectives on experience (Diverging) while the Deciding style has a strong preference for closing on the single best option for action (Converging). The formulas for calculating the continuous scores on these combination dialectics are reported on page 42. Figure 5 depicts this expanded learning cycle and illustrates how an individual's particular style represents their preferred space in the cycle.

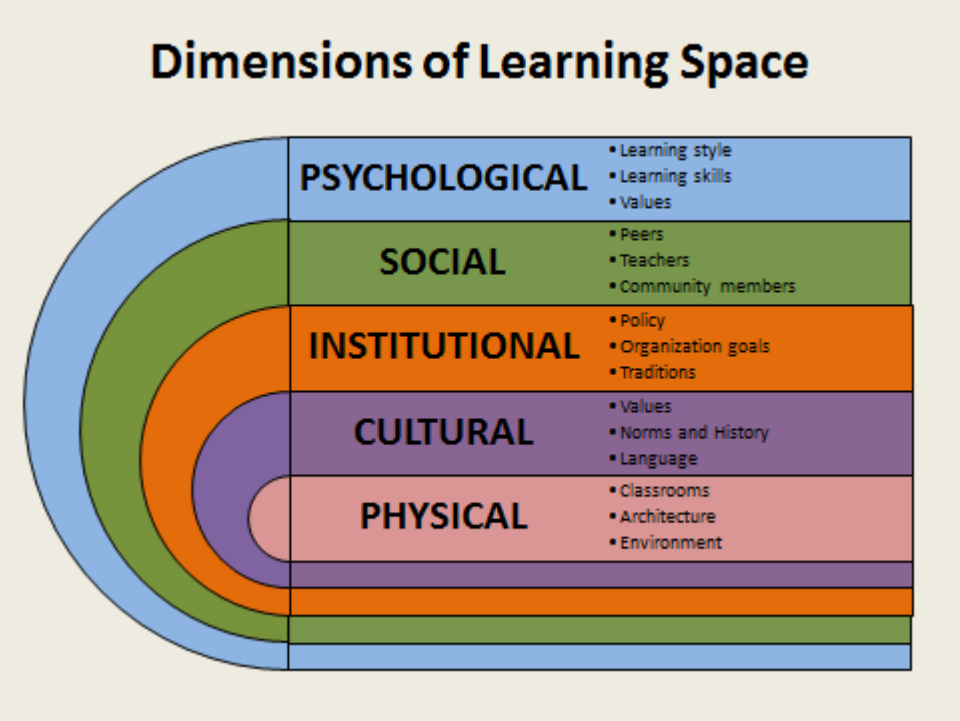
Figure 5


The Nine Learning Styles and the Four Dialectics of the Learning Cycle
Concrete Experience
Accommodating
Diverging
Experiencing
Initiating
Imagining
Active Experimentation
Acting
Balancing
Reflecting
Reflective Observation
Deciding
Analyzing
Thinking
Converging
Assimilating
Abstract Conceptualization

LEARNING SPACE

If learning is to occur, it requires a space for it to take place. While, for most, the concept of learning space first conjures up the image of the physical classroom environment, it is much broader and multi-dimensional. Dimensions of learning space include physical, cultural, institutional, social and psychological aspects (See Figure 6).

Figure 6



In ELT these dimensions all come together in the experience of the learner. This concept of learning space builds on Kurt Lewin's field theory and his concept of life space (1951). For Lewin, person and environment are interdependent variables where behavior is a function of person and environment and the life space is the total psychological environment, which the person experiences subjectively. To take time as an example, in many organizations today employees are so busy doing their work that they feel that there is no time to learn how to do things better. This feeling is shaped by the objective conditions of a hectic work schedule along with the expectation that time spent reflecting will not be rewarded.

Three other theoretical frameworks inform the ELT concept of learning space. Urie Bronfrenbrenner's (1977, 1979) work on the ecology of human development has made significant sociological contributions to Lewin's life space concept. He defines the ecology of learning/development spaces as a topologically nested arrangement of structures each contained within the next. The learner's immediate setting such as a course or classroom is called the *microsystem,* while other concurrent settings in the person's life such as other courses, the dorm or family are referred to as the *mesosystem.* The *exosystem* encompasses the formal and informal social structures that influence the person's immediate environment,

such as institutional policies and procedures and campus culture. Finally, the *macrosystem* refers to the overarching institutional patterns and values of the wider culture, such as cultural values favoring abstract knowledge over practical knowledge, that influence actors in the person's immediate microsystem and mesosystem. This theory provides a framework for analysis of the social system factors that influence learners' experience of their learning spaces.

Another important contribution to the learning space concept is situated learning theory (Lave and Wenger 1991). Like ELT situated learning theory draws on Vygotsky's (1978) activity theory of social cognition for a conception of social knowledge that conceives of learning as a transaction between the person and the social environment. Situations in situated learning theory like life space and learning space are not necessarily physical places but constructs of the person's experience in the social environment. These situations are embedded in communities of practice that have a history, norms, tools, and traditions of practice. Knowledge resides, not in the individual's head, but in communities of practice. Learning is thus a process of becoming a member of a community of practice through legitimate peripheral participation (e.g. apprenticeship). Situated learning theory enriches the learning space concept by reminding us that learning spaces extend beyond the teacher and the classroom. They include socialization into a wider community of practice that involves membership, identity formation, transitioning from novice to expert through mentorship and experience in the activities of the practice, as well as the reproduction and development of the community of practice itself as newcomers replace old-timers.

Finally, in their theory of knowledge creation, Nonaka and Konno (1998) introduce the Japanese concept of "ba", a "context that harbors meaning", which is a shared space that is the foundation for knowledge creation. "Knowledge is embedded in *ba,* where it is then acquired through one's own experience or reflections on the experiences of others." (Nonaka and Konno 1998:40) Knowledge embedded in *ba* is tacit and can only be made explicit through sharing of feelings, thoughts and experiences of persons in the space. For this to happen, the *ba* space requires that individuals remove barriers between one another in a climate that emphasizes "care, love, trust, and commitment". Learning spaces similarly require norms of psychological safety, serious purpose, and respect to promote learning.

Since a learning space is in the end what the learner experiences it to be, it is the psychological and social dimensions of learning spaces that have the most influence on learning. From this perspective learning spaces can be viewed as aggregates of human characteristics. "Environments are transmitted through people and the dominant features of a particular environment are partially a function of the individuals who inhabit it" (Strange & Banning, 2001). Using the "human aggregate" approach, the experiential learning space is defined by the attracting and repelling forces (positive and negative valences) of the poles of the dual dialectics of action/reflection and experiencing/conceptualizing, creating a two dimensional map of the regions of the learning space like that shown in Figure 4. An individual's learning style positions him/her in one of these regions depending on the equilibrium of forces among action, reflection, experiencing and conceptualizing. As with the concept of life space, this position is determined by a combination of individual disposition and characteristics of the learning environment.

The KLSI measures an individual's preference for a particular region of the learning space, their home region so to speak. The regions of the ELT learning space offer a typology of the different types of learning based on the extent to which they require action vs. reflection and experiencing vs. thinking, thereby emphasizing some stages of the learning cycle over others. A number of studies of learning spaces in higher education have been conducted using the human aggregate approach by showing the percentage of students whose learning style places them in the different learning space regions (Kolb & Kolb, 2005a; Eickmann, Kolb & Kolb, 2004). Figure 7, for example, shows the ELT learning space of the MBA program in a major management school. In this particular case, students are predominately concentrated in the abstract and active regions of the learning space, as are the faculty. This creates a learning space that tends to emphasize the quantitative and technical aspects of management over the human and relationship factors.

Figure 7. The Learning Space of an MBA Program Defined by the Learning Styles of MBA Students (n = 1286; Kolb & Kolb 2005a)

Concrete Experience

	Initiating 10.1%	Experiencing 6%	Imagining 5.1%
Active Experimentation	Acting 13.5%	Balancing 10.2%	Reflecting 9.3%
	Deciding 12.7%	Thinking 17%	Analyzing 16%

Reflective Observation

Abstract Conceptualization

The ELT learning space concept emphasizes that learning is not one universal process but a map of learning territories, a frame of reference within which many different ways of learning can flourish and interrelate. It is a holistic framework that orients the many different ways of learning to one another. The process of experiential learning can be viewed as a process of locomotion through the learning regions that is influenced by a person's position in the learning space. One's position in the learning space defines their experience and thus defines their "reality." Teachers objectively create learning spaces by the information and activities they offer in their course; but this space is interpreted in the students' subjective experience through the lens of their learning style.

Creating learning spaces for experiential learning

In our recent research we have focused on the characteristics of learning spaces that maximize learning and development and have developed principles for creating them (Kolb & Kolb, 2005a). For a learner to engage fully in the learning cycle, a space must be provided to engage in the four modes of the cycle—feeling, reflection, thinking, and action. It needs to be a hospitable, welcoming space that is characterized by respect for all. It needs to be safe and supportive, but also challenging. It must allow learners to be in charge of their own learning and allow time for the repetitive practice that develops expertise.

The enhancement of experiential learning can be achieved through the creation of learning spaces that promote growth producing experiences for learners. A central concept in Dewey's educational philosophy is the continuum of experience that arrays experiences that promote or inhibit learning. "The belief that all genuine education comes about through experience does not mean that all experiences are genuinely educative…For some experiences are mis-educative. Any experience is mis-educative that has the effect of arresting or distorting the growth of further experience…Hence the central problem of an education based on experience is to select the kind of present experiences that live fruitfully and creatively in subsequent experiences" (Dewey 1938, p. 25-28). There are a number of educational principles that flow from this philosophy.

Respect for Learners and their Experience. A growth producing experience in the philosophy of experiential learning refers not just to a direct experience related to a subject matter under study but to the total experiential life space of the learner. This includes the physical and social environment and the quality of relationships. We refer to this as the Cheers/Jeers experiential continuum. At one end learners feel that they are members of a learning community who are known and respected by faculty and colleagues and whose experience is taken seriously, a space "where everybody knows your name". At the other extreme are "mis-educative" learning environments where learners feel alienated, alone, unrecognized and devalued. Learning and growth in the Jeers environment "where nobody knows your name" can be difficult if not impossible. This principle an be problematic for even the finest educational institutions. President Lawrence Summers of Harvard dedicated his 2003 commencement address to the introduction of a comprehensive examination of the undergraduate program, motivated in part by a letter he received from a top science student which contained the statement, "I am in the eighth semester of college and there is not a single science professor here who could identify me by name." Summers concludes "The only true measure of a successful educational model is our students' experience of it." (Summers 2003:64)

Begin Learning with the Learner's Experience of the Subject Matter. To learn experientially one must first of all own and value their experience. Students will often say, "But I don't have any experience." meaning that they don't believe that their experience is of any value to the teacher or for learning the subject matter at hand. The new science of learning (Bransford, Brown and Cocking 2000) is based on the cognitive constructivist theories of Piaget and Vygotsky that emphasize that people construct new knowledge and understanding from what they already know and believe based on their previous experience.

Zull (2002) suggests that this prior knowledge exists in the brain as neuronal networks which cannot be erased by a teacher's cogent explanation. Instead the effective teacher activates prior knowledge, building on exploration of what students already know and believe, on the sense they have made of their previous concrete experiences. Beginning with these or related concrete experiences allows the learner to re-examine and modify their previous sense-making in the light of new ideas.

Creating and Holding a Hospitable Space for Learning. To learn requires facing and embracing differences; be they differences between skilled expert performance and one's novice status, differences between deeply held ideas and beliefs and new ideas or differences in the life experience and values of others that can lead to understanding them. These differences can be challenging and threatening, requiring a learning space that encourages the expression of differences and the psychological safety to support the learner in facing these challenges (Sanford 1966). As Robert Kegan says, "…people grow best where they continuously experience an ingenious blend of challenge and support" (1994: 42). As Kegan implies by his use of the term "ingenious blend", creating and holding this learning space is not easy. He notes that while educational institutions have been quite successful in challenging students, they have been much less successful in providing support. One reason for this may be that challenges tend to be specific and immediate while support must go beyond an immediate "You can do it." statement. It requires a climate or culture of support that the learner can trust to "hold" them over time. In *Conversational Learning* (Baker, Jensen and Kolb 2002) we draw on the work of Henri Nouwen (1975) and Parker Palmer (1983, 1990, 1998) to describe this challenging and supportive learning space as one that welcomes the stranger in a spirit of hospitality where "students and teachers can enter into a fearless communication with each other and allow their respective life experiences to be their primary and most valuable source of growth and maturation" (Nouwen: 60).

Making Space for Conversational Learning. Human beings naturally make meaning from their experiences through conversation. Yet genuine conversation in the traditional lecture classroom can be extremely restricted or nonexistent. At the break or end of the class the sometimes painfully silent classroom will suddenly come alive with spontaneous conversation among students. Significant learning can occur in these conversations, although it may not always be the learning the teacher intended. Making space for good conversation as part of the educational process provides the opportunity for reflection on and meaning making about experiences that improves the effectiveness of experiential learning (Keeton, Sheckley, and Griggs 2002, Bunker 1999). For example the creation of learning teams as part of a course promote effective learning when psychologically safe conditions are present (Wyss-Flamm 2002). *Conversational Learning* describes the dimensions of spaces that allow for good conversation. Good conversation is more likely to occur in spaces that integrate thinking and feeling, talking and listening, leadership and solidarity, recognition of individuality and relatedness and discursive and recursive processes. When the conversational space is dominated by one extreme of these dimensions, e.g. talking without listening, conversational learning is diminished.

Making Space for Development of Expertise. With vast knowledge bases that are ever changing and growing in every field, many higher education curricula consist of course

after course "covering" a series of topics in a relatively superficial factual way. Yet as the National Research Council in it's report on the new science of learning recommends on the basis of research on expert learners; effective learning requires not only factual knowledge, but the organization of these facts and ideas in a conceptual framework and the ability to retrieve knowledge for application and transfer to different contexts (Bransford, Brown, and Cocking 2002). Such deep learning is facilitated by deliberate, recursive practice on areas that are related to the learner's goals (Keeton, Sheckley, and Griggs 2002). The process of learning depicted in the experiential learning cycle describes this recursive spiral of knowledge development. Space needs to be created in curricula for students to pursue such deep experiential learning in order to develop expertise related to their life purpose.

Making Spaces for Acting and Reflecting . Learning is like breathing; it involves a taking in and processing of experience and a putting out or expression of what is learned. As Dewey noted, "…nothing takes root in mind when there is no balance between doing and receiving. Some decisive action is needed in order to establish contact with the realities of the world and in order that impressions may be so related to facts that their value is tested and organized." (1934: 45) Yet many programs in higher education are much more focused on impressing information on the mind of the learner than on opportunities for the learners to express and test in action what they have learned. Many courses will spend 15 weeks requiring students to take in volumes of information and only a couple of hours expressing and testing their learning, often on a multiple choice exam. This is in contrast to arts education built on the demonstration-practice-critique process where active expression and testing are continuously involved in the learning process. Zull (2002) suggests that action may be the most important part of the learning cycle because it closes the learning cycle by bringing the inside world of reflection and thought into contact with the outside world of experiences created by action. (cf. Dewey 1897) Keeton, Sheckley and Gross (2002) propose another level of action/reflection integration, emphasizing the importance of active reflection in deepening learning from experience.

Making Spaces for Feeling and Thinking. We have seen a polarization between feeling and thinking in the contrast between the feeling oriented learning space of CIA arts education and the thinking oriented learning spaces of the Case undergraduate and MBA programs (Kolb & Kolb 2005a). It seems that educational institutions tend to develop a learning culture that emphasizes the learning mode most related to their educational objectives and devalues the opposite learning mode. Yet, Damasio (1994, 2003), LeDoux (1997), Zull (2002) and others offer convincing research evidence that reason and emotion are inextricably related in their influence on learning and memory. Indeed it appears that feelings and emotions have primacy in determining whether and what we learn. Negative emotions such as fear and anxiety can block learning, while positive feelings of attraction and interest may be essential for learning. To learn something that one is not interested in is extremely difficult.

Making Space for Inside-out Learning. David Hunt (1987, 1991) describes inside-out learning as a process of beginning with oneself in learning by focusing on one's experienced knowledge; the implicit theories, metaphors, interests, desires and goals that guide experience. Making space for inside-out learning by linking educational experiences to

the learner's interests kindles intrinsic motivation and increases learning effectiveness. Under the proper educational conditions, a spark of intrinsic interest can be nurtured into a flame of committed life purpose. (Dewey 1897) Yet learning spaces that emphasize extrinsic reward can drive out intrinsically motivated learning (Kohn 1993, Deci and Ryan 1985, Ryan and Deci 2000). Long ago Dewey described the trend toward emphasis on extrinsic reward in education and the consequences for the teacher who wields the carrot and stick: "Thus in education we have that systematic depreciation of interest which has been noted…Thus we have the spectacle of professional educators decrying appeal to interest while they uphold with great dignity the need of reliance upon examinations, marks, promotions and emotions, prizes and the time honored paraphernalia of rewards and punishments. The effect of this situation in crippling the teacher's sense of humor has not received the attention which it deserves. (1916: 336)

Making Space for Learners to Take Charge of their own Learning . Many students enter higher education conditioned by their previous educational experiences to be passive recipients of what they are taught. Making space for students to take control of and responsibility for their learning can greatly enhance their ability to learn from experience. Some use the term self-authorship to describe this process of constructing one's own knowledge vs. passively receiving knowledge from others, considering self-authorship to be a major aim of education (Kegan 1994, King 2003, Baxter-Magolda 1999). Others describe this goal as increasing students' capacity for self direction (Boyatzis 1994, Robertson 1988). The Management Development and Assessment course in the Case MBA program aims to develop student self direction through assessment and feedback on learning skills and competencies and the development of a learning plan to achieve their career/life goals (Boyatzis 1994). Bransford, Brown, and Cocking (2002) argue for the development of meta-cognitive skills to promote active learning. By developing their effectiveness as learners (Keeton, Sheckley and Griggs 2002), students can be empowered to take responsibility for their own learning by understanding how they learn best and the skills necessary to learn in regions that are uncomfortable for them. Workshops on experiential learning and learning styles can help students to develop meta-cognitive learning skills. At CIA and the Case undergraduate programs student workshops help students interpret their LSI scores and understand how to use this information to improve their learning effectiveness. John Reese at the University of Denver Law School conducts "Connecting with the Professor" workshops in which students select one of four teaching styles based on the four predominant learning styles that they have difficulty connecting with. The workshop gives multiple examples of remedial actions that the learner may take to correct the misconnection created by differences in teaching/learning styles. Peer group discussions among law students give an opportunity to create new ideas about how to get the most from professors with different learning/teaching styles (Reese 1998).

THE SPIRAL OF LEARNING AND ADULT DEVELOPMENT

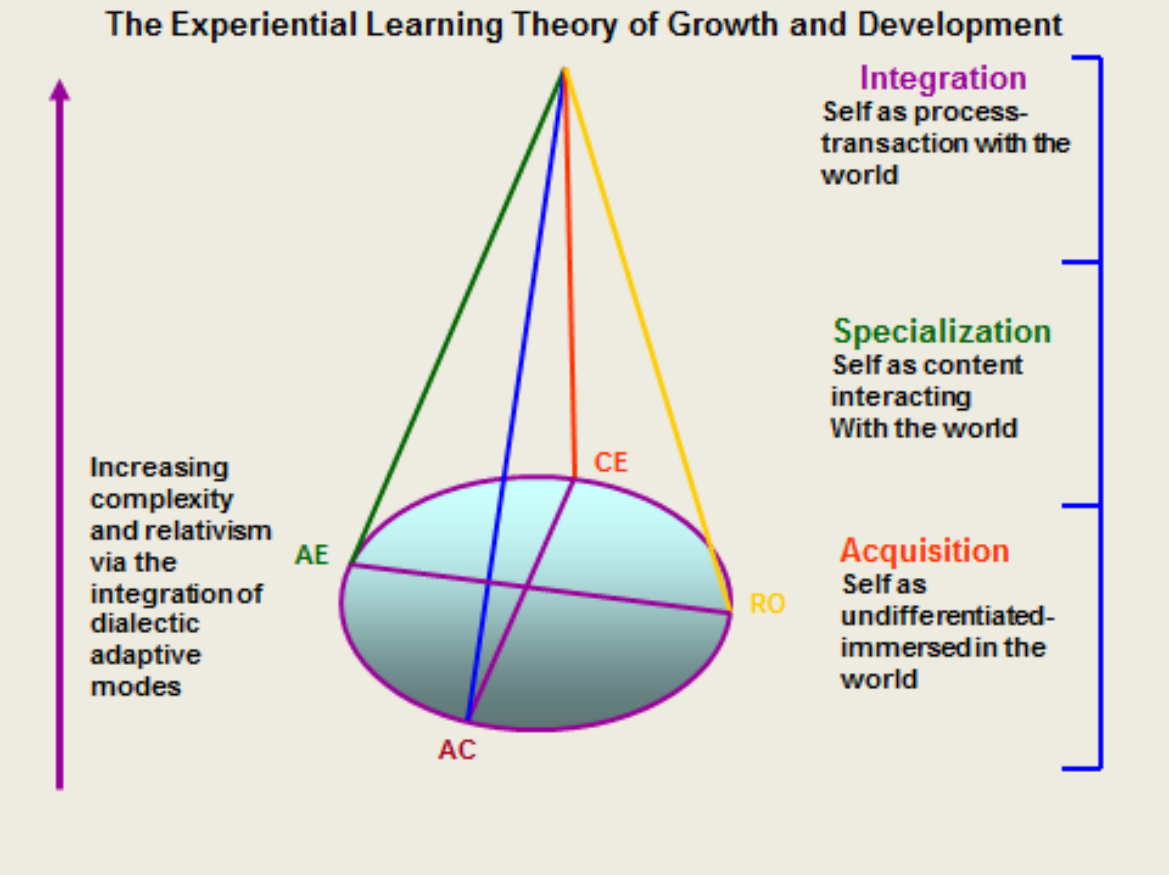
In ELT, adult development occurs through learning from experience. This is based on the idea that the experiential learning cycle is actually a learning *spiral*. When a concrete experience is enriched by reflection, given meaning by thinking and transformed by action, the new experience created becomes richer, broader and deeper. Further iterations of the cycle continue the exploration and transfer to experiences in other contexts. In this process learning is integrated with other knowledge and generalized to other contexts leading to higher levels of adult development.

Zull (2002) explained a link between ELT and neuroscience research, suggesting that the spiraling process of experiential learning is related to the process of brain functioning. Humberto Maturana (1970) also arrived at the concept of a spiral when he searched for the pattern of organization that characterizes all living systems. He concluded that all living systems are organized in a closed circular process that allows for evolutionary change in a way that circularity is maintained. He called this process *autopoeisis,* which means "self-making," emphasizing the self-referential and self-organizing nature of life. Applying autopoeisis to cognition, he argued that the process of knowing was identical to autopoeisis, the spiraling process of life (Maturana & Varela, 1980). As these researchers suggest, the organization of the mind can be viewed as networks of *autopoeitic* learning spirals which are embodied in the neuronal networks that cover the surface layer of the neo-cortex. These neuronal networks are strengthened and enlarged by spirals of learning recursively cycling through these major regions of the neo-cortex.

Progress toward development is seen as increases in the complexity and sophistication of the dimensions associated with the four modes of the learning cycle—affective, perceptual, symbolic and behavioral complexity—and the integration of these modes in a flexible full cycle of learning.

The ELT developmental model (Kolb, 1984) follows Jung's theory that adult development moves from a specialized way of adapting toward a holistic integrated stage that he calls individuation. The model defines three stages: (1) *acquisition,* from birth to adolescence where basic abilities and cognitive structures develop; (2) *specialization,* from formal schooling through the early work and personal experiences of adulthood where social, educational, and organizational socialization forces shape the development of a particular, specialized learning style; and (3) *integration* in mid-career and later life where non-dominant modes of learning are expressed in work and personal life. Development through these stages is characterized by increased integration of the dialectic conflicts between the four primary learning modes (AC-CE and AE-RO) and by increasing complexity and relativism in adapting to the world. Each of the learning modes is associated with a form of complexity that is used in conscious experience to transform sensory data into knowledge such that development of CE increases affective complexity, of RO increases perceptual complexity, of AC increases symbolic complexity, and of AE increases behavioral complexity (Figure 8). These learning modes and complexities create a multi-dimensional developmental process that is guided by an individual's particular learning style and life path.

Figure 8



The concept of *deep learning* describes the developmental process of learning that fully integrates the four modes of the experiential learning cycle—experiencing, reflecting, thinking and acting (Jensen & Kolb, 1994; Border, 2007). Deep learning refers to the kind of learning that leads to development in the ELT model. Development toward deep learning is divided into three levels. In the first level learning is registrative and performance-oriented, emphasizing the two learning modes of the specialized learning styles. The second level is interpretative and learning-oriented involving three learning modes, and the third level is integrative and development-oriented involving all four learning modes in a holistic learning process. In his foundational work, *Learning from Experience toward Consciousness,* William Torbert (1972) described these levels of learning as a three-tiered system of feedback loops; work that has been extended by Chris Argyris, Donald Schön, Peter Senge and others in the concepts of single and double loop learning. The traditional lecture course, for example, emphasizes first level, registrative learning emphasizing the learning modes of reflection and abstraction involving little action (often multiple choice tests that assess registration of concepts in memory) and little relation to personal experience. Adding more extensive learning assessments that involve practical application of concepts covered can create second level learning involving the three learning modes where reflection supplemented by action serve to further deepen conceptual understanding. Further addition of learning experiences that involve personal experience such as internships or field projects create the potential for third level integrative learning (cf. Kolb `1984, Chapter 6). As a counter example, an

internship emphasizes registrative learning via the modes of action and experience. Deeper interpretative learning can be enhanced by the addition of activities to stimulate reflection such as team conversation about the internship experience and/or student journals. Linking these to the conceptual material related to the experience adds the fourth learning mode, abstraction and integration though completion of the learning spiral.

A study by Clarke (1977) of the accounting and marketing professions illustrates the ELT developmental model. The study compared the learning styles of cross-sectional samples of accounting and marketing students and professionals in school and at lower, middle and senior level career stages. The learning styles of marketing and accounting students were similar, being fairly balanced among the four learning modes. Lower level accountants had convergent, abstract and active learning styles, and this convergent emphasis was even more pronounced in middle-level accountants, reflecting a highly technical specialization. The senior level accountants, however, became more accommodative in learning style integrating their non-dominant concrete learning orientation. Clark found a similar pattern of development in the marketing profession. Gypen (1981) found the same move from specialization to integration in his study of the learning styles of a cross-sectional sample of social work and engineering university alumni from early to late career. “As engineers move up from the bench to management positions, they complement their initial strengths in abstraction and action with the previously non-dominant orientations of experience and reflection. As social workers move from direct service into administrative positions they move in the opposite direction of the engineers.” (1981: ii)

Notice that in both studies the transitions to non-dominant learning modes in later life stages are associated with changes in the work environment. Development appears not to be solely a function of individual factors alone, but of the transaction between the person and his or her environment. For example, engineers who move from the “bench” into management may become more integrated because of the demands of the interpersonal and unstructured management role. However, choosing to move into the management position required individual development in interest and talent to do so. It is also important to note that these cross-sectional studies do not offer proof of the sequential development through stages predicted in Jung’s model. This would require longitudinal studies of individuals showing that they must first be in a specialized developmental stage before proceeding to the integrative stage. In fact, in spite of their theoretical similarity, elegance and plausibility, we are aware of no empirical evidence for stage-related development in any of the theories of adult development. This evidence is lacking in both the psychoanalytic models of Erikson and Loevinger and the Piaget inspired theories of King and Kitchner, Kegan, or Perry.

For both of these reasons, in our recent work we have considered development in a way that is more context specific, less age related and non-hierarchical. ELT describes registrative, interpretative and integrative levels of consciousness and three modes of adaptation -performance, learning and development (Boyatzis & Kolb, 2000) - which individuals will enter into at different times and situations depending on their life circumstances (Table 1). While these modes may be typical of the acquisition, specialization and development ELT developmental stages, there may be many exceptions in individual cases. Thus, a young person who has been primarily in a performance mode may transition

into a period in the development mode “to figure out what to do with his life” or an older person in the development mode may return to the performance mode to work on a project of importance.

LEARNING FLEXIBILITY

Another important aspect of learning style is learning flexibility, the extent to which an individual adapts his or her learning style to the demands of the learning situation. As we have seen above, learning style is not a fixed personality trait but more like a habit of learning shaped by experience and choices—it can be an automatic, unconscious mode of adapting or it can be consciously modified and changed. The stability of learning style arises from consistent patterns of transaction between individuals and learning situations in their life. This process is called accentuation—the way we learn about a new situation determines the range of choices and decisions we see, the choices and decisions we make influence the next situation we live through and this situation further influences future choices. Learning styles are thus specialized modes of adaptation that are reinforced by the continuing choice of situations where a style is successful (Kolb 1984).

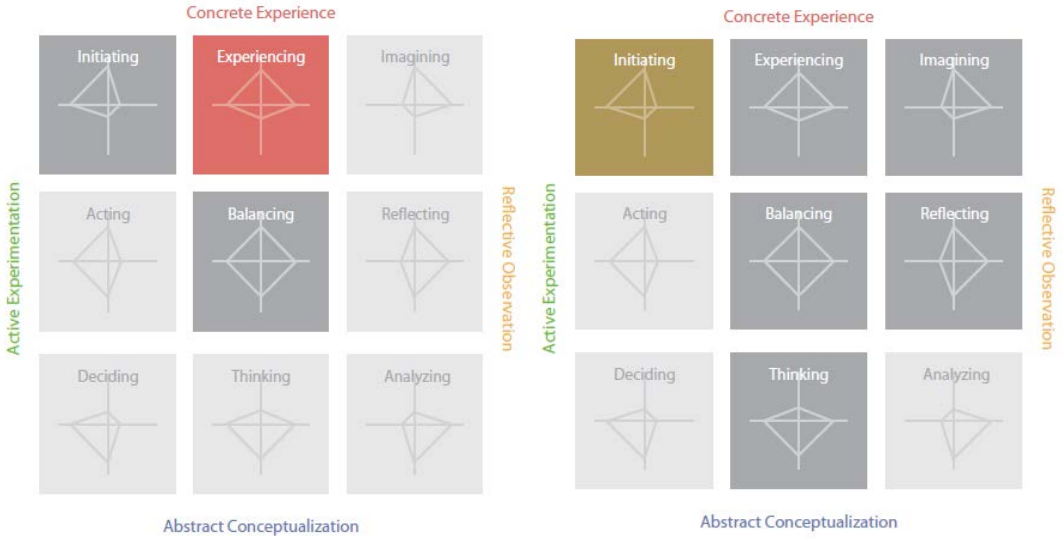
Since a specialized learning style represents an individual preference for only one or two of the four modes of the learning cycle, its effectiveness is limited to those learning situations that require these strengths. Learning flexibility indicates the development of a more holistic and sophisticated learning process The learning style types described above portray how one prefers to learn in general. Many individuals feel that their learning style type accurately describes how they learn most of the time. They are consistent in their approach to learning. Others, however, report that they tend to change their learning approach depending on what they are learning or the situation they are in. They may say, for example, that they use one style in the classroom and another at home with their friends and family. These are flexible learners.

Learning flexibility indicates the development of a more holistic and sophisticated learning process. Following Jung's theory that adult development moves from a specialized way of adapting toward a holistic integrated way, development in learning flexibility is seen as a move from specialization to integration. Integrated learning is a process involving a creative tension among the four learning modes that is responsive to contextual demands. Learning flexibility is the ability to use each of the four learning modes to move freely around the learning cycle and to modify one’s approach to learning based on the learning situation. Experiencing, reflecting, thinking and acting each provide valuable perspectives on the learning task in a way that deepens and enriches knowledge.

This can be seen as traveling through each of the regions of the learning space in the process of learning. The flexibility to move from one learning mode to another in the learning cycle is important for effective learning. Learning flexibility can help us move in and out of the learning space regions, capitalizing on the strengths of each learning style. Learning flexibility broadens the learning comfort zone and allows us to operate comfortably and effectively in more regions of the learning space, promoting deep learning and

development. In addition to providing a measure of how flexible one is in their approach to learning, the online KLSI 4.0 (Kolb & Kolb 2011) also provides an indication of which learning space they move to in different learning contexts—their back-up learning styles. Figure 9 shows the backup styles of Initiating and Balancing for an Experiencing type with a low flexibility score and the backup styles of Experiencing, Imagining, Balancing, Reflecting and Thinking for an Initiating learning style with a high flexibility score. High flexibility individuals tend to show more backup styles and hence a greater ability to move around the learning cycle (See Chapter 6).

Figure 9
Backup Styles for High and Low Learning Flexibility Learners



DELIBERATE EXPERIENTIAL LARNING

A primary purpose of the KLSI is to empower learners to understand and intentionally improve their learning capability. This ability to deliberately learn from experience is perhaps the most powerful source of adult learning. In leadership development for example, Ashford and DeRue point out, "…consider the fact that leadership development programs customarily teach leadership concepts and skills, but rarely do development programs teach individuals how to learn leadership — which is ironic considering that over 70% of leadership development occurs as people go through the ups and downs of challenging, developmental experiences on the job. We contend that the return on investment in leadership development would be much greater if organizations invested in developing individuals' skills related to the learning of leadership from lived experiences, as opposed to simply teaching leadership concepts, frameworks, and skills.(2012 p147). Deliberate experiential learning draws on theories in three areas; meta-cognition (Kolb & Kolb 2009), mindfulness (Yeganeh 2006; Yeganeh & Kolb 2009),) and studies of expert learning called deliberate practice (Ericsson, Krampe & Tesch-Römer 1993).

Meta-cognition--Understanding yourself as a learner

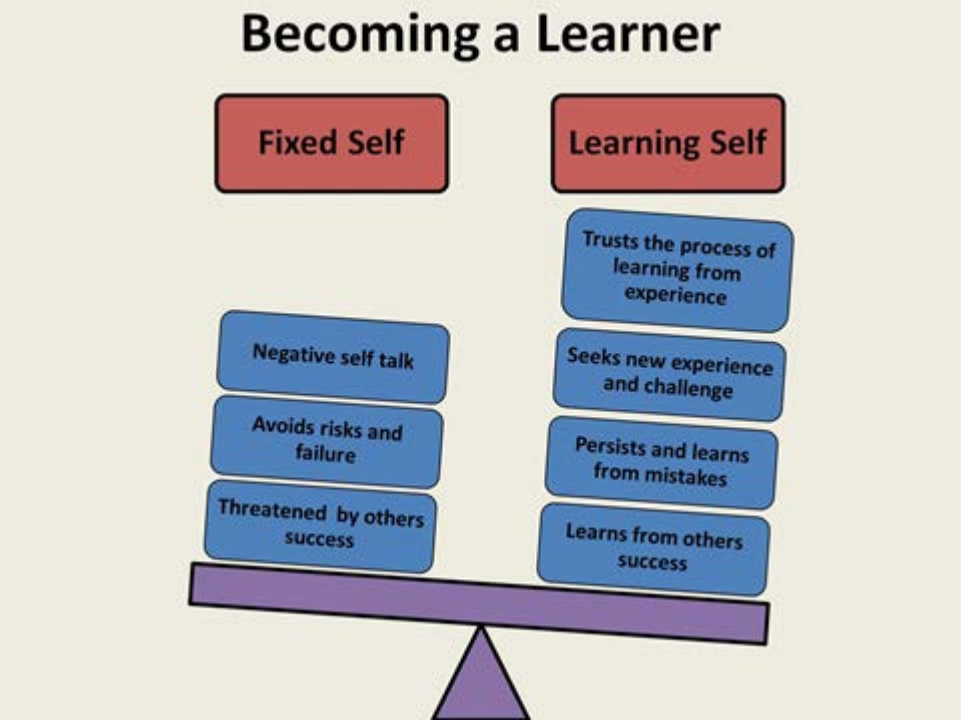
Deliberate experiential learning refers to individuals' conscious meta-cognitive control of their learning process that enables them to monitor and select learning approaches that work best for them in different learning situations. In the late 1970's Flavell (1979) introduced the concept of meta-cognition. He divided meta-cognitive knowledge into three sub-categories: 1) Knowledge of person variables refers to general knowledge about how human beings learn and process information, as well as individual knowledge of one's own learning processes. 2) Task variables include knowledge about the nature of the task and what it will require of the individual. 3) knowledge about strategy variables include knowledge about ways to improve learning as well as conditional knowledge about when and where it is appropriate to use such strategies.

By using the experiential learning model, learners can better understand the learning process, themselves as learners and the appropriate use of learning strategies based on the learning task and environment. When individuals engaged in the process of learning by reflective monitoring of the learning process they are going through, they can begin to understand important aspects of learning: how they move through each stage of the learning cycle, the way their unique learning style fits with how they are being taught, and the learning demands of what is being taught. This comparison results in strategies for action that can be applied in their ongoing learning process.

Develop a learning identity. A key aspect of meta-cogntive learning is a person's beliefs about themselves, particularly their views about their ability to learn. At the extreme, if a person does not believe that they can learn they won't. Learning requires conscious attention, effort and "time on task". These activities are a waste of time to someone who does not believe that they have the ability to learn. On the other hand there are many successful individuals who attribute their achievements to a learning attitude. Oprah Winfrey for example has said, "I am a woman in process. I'm just trying like everybody else. I try to take every conflict, every experience, and learn from it. Life is never dull."

One's self-identity is deeply held. One is likely to defend against experiences that contradict this identity. For the vast majority of us our self-identity is a mix of fixed and learning beliefs. We may feel that we are good at learning some things like sports and not good at others like mathematics. Every success or failure can trigger a reassessment of one's learning ability. Figure 10 depicts one's self-identity as balancing characteristics that reinforce a fixed self and a learning self. Fixed self characteristics shift the balance to the fixed self. Factors associated with the learning self tip the balance toward becoming a learner.

Figure 10



From the above figure we suggest several practical steps for developing a positive meta-cognitive learning identity.

Trust your experience. Place experience at the center of your learning process, making it the focal point of your choices and decisions. This does not mean that you shouldn't learn from experts or the experience of others since this advice is also part of your experience. The key is to own your choices and validate them in your experience. When you do this you take charge of your learning and your life.

Trust the learning process. Avoid an excessive focus on the outcomes of immediate performance and focus instead on the longer term recursive process of learning by tracking your performance progress over time. Rarely is a single performance test a matter of life and death, and to treat it as such only reinforces a fixed identity. Every performance is an occasion for learning and improvement in future performances.

Redefine your relationship to failure. No one likes to fail but failure is an inevitable part of doing something new. Thomas Edison provided a role model for the learning response to failure when he said "Failure is the most important ingredient for success." James Dyson, the inventor of the Dyson vacuum cleaner and founder of Dyson, Inc, sees Edison as a role model saying he, "achieved great success through repeated failure. His 10000 failures pale in comparison to his 1093 US patents. Each one of Edison's inventions, from the Dictaphone to the light bulb came from his inability to give up" (Yang 2008:28).

Failures can also help focus your priorities and life path on your talents and strengths. In her commencement address to the 2008 graduates of Harvard University, J. K. Rowling described the low period in her life after graduation, which was marked by failure on every front, and talked about its benefits; "…failure meant a stripping away of the inessential. I stopped pretending to myself that I was anything other than what I was, and began to direct my energy into finishing the only work that mattered to me. Had I succeeded at anything else, I might never have found the determination to succeed in the one arena where I believed I truly belonged. I was set free because my greatest fear had been realized and I was still alive, and I still had a daughter whom I adored, and I had an old typewriter and a big idea." (Rowling 2008:56)

Let go of strong emotional responses in order to learn from failure. Failures, losses and mistakes provoke inevitable emotional responses. Yet it is important to learn to regulate emotional reactions that block learning and feed into a fixed identity. Golfers who slam their club and curse themselves and the game after a bad shot lose the opportunity to coolly analyze their mistake and plan for corrections on the next hole. An effective way to deal with the emotions that follow judging oneself a failure is to breath calmly and intentionally while accepting the current moment as it is. This enables a clearer mind with which to move forward. *Risk losing.* Joel Waitzkin in *The art of learning* provides a handbook of his meta-cognitive learning based on his process of becoming first a chess master and then a martial arts champion. He emphasizes the importance of losing in order to learn how to win. "If a big strong guy comes into a martial arts studio and someone pushes him, he wants to resist and push the guy back to prove that he is a big strong guy. The problem is that he isn't learning anything by doing this. In order to grow, he needs to give up his current mindset. (Waitzkin 2007: 107).

Reassess your beliefs about how you learn and what you are good at. It is important to consciously reflect on and choose how you define yourself as a learner. Often people are unaware of the way in which they characterize themselves and their abilities.

Monitor the messages you send yourself. Pay attention to your self-talk. Saying to yourself, "I am stupid." or, "I am no good at …" matters and reinforces a negative fixed identity; just as saying, "I can do this" reinforces a positive learning identity. Beware of internalized oppression. Some of these messages are introjections from others that you have swallowed without careful examination.

Balance your success/failure accounts. Most of us remember our failures more vividly than our successes. For example, in our experience as teachers we both tend to focus on the one or two negative remarks in our course ratings and ignore the praise and positive reactions. The danger of this type of focus is adjusting one's teaching style to suit one or two negative comments and risking losing the majority of positive experiences in the room. A deeper danger is that such a focus will negatively shape longer term thoughts and behaviors about oneself (Blackwell, Trzesniewski, & Dweck 2007:259-260). Sometimes it is useful to make an inventory of learning strengths and successes to balance your accounts.

Learning style. In addition to believing in ourselves as learners, it is also important to understand how it is that we learn best, our learning style. An understanding of one's unique learning preferences and capabilities, and the match between these and the demands of learning tasks, can increase learning effectiveness. It can suggest why performance is not optimal and suggest strategies for improvement, as well as help explain why some topics and courses are interesting and others are painful. It can also help explain why some develop a non-learning self-identity. Our most gratifying experiences in teaching individuals about their learning style have been when they come up and say, "My whole life I thought I was stupid because I didn't do well in school. Now I realize that it is just because I learn in a different way than schools teach."

Those who use the KLSI to assess their learning style often decide that they wish to develop their capacity to engage in one or more of the four learning modes, experiencing (CE), reflecting (RO), thinking (AC), and acting (AE). In some cases this is based on a desire to develop a weak mode in their learning style. In others it may be to increase capability in a mode that is particularly important for their learning tasks. Because of the dialectic relationships among the learning modes, containing the inhibiting effects of opposing learning modes can be as effective in getting into a mode as actively trying to express it. Overall learning effectiveness is improved when individuals are highly skilled in engaging all four modes of the learning cycle. One way to develop in the learning modes is to develop the skills associated with them. The Learning Skills Profile (Boyatzis & Kolb, 1991, 1992, 1995) was created to help learners assess the learning skills associated with the four modes of the learning cycle—interpersonal skills for CE, information skills for RO, analytic skills for AC, and action skills for AE.

Developing the capacity for experiencing. Experiencing requires fully opening oneself to direct experience. Direct experience exists only in the here and now, a present moment of endless depth and extension that can never be fully comprehended. In fact, the thinking mode, being too much "in your head," can inhibit the ability to directly sense and feel the immediate moment. Engagement in concrete experience can be enhanced by being present in the moment and attending to direct sensations and feelings. This presence and attention are particularly important for interpersonal relationships. Interpersonal skills of leadership, relationship, and giving and receiving help in the development and expression of the experiencing mode of learning.

Developing the capacity for reflecting. Reflection requires space and time for it to take place. It can be inhibited by impulsive desires and/or pressures to take action. It can be enhanced by the practices of deliberately viewing things from different perspective and empathy. Stillness and quieting the mind foster deep reflection. Information skills of sense making, information gathering, and information analysis can aid in the development and expression of the reflecting mode of learning.

Developing the capacity for thinking. Thinking requires the ability to represent and manipulate ideas in your head. It can be distracted by intense direct emotion

and sensations as well as pressure to act quickly. Engagement in thinking can be enhanced by practicing theoretical model building and the creation of scenarios for action. Analytical skills of theory building, quantitative data analysis, and technology management can aid in the development and expression of the thinking mode of learning.

Developing the capacity for action. Acting requires commitment and involvement in the practical world of real consequences. In a sense it is the "bottom line" of the learning cycle, the place where internal experiencing, reflecting, and thinking are tested in reality. Acting can be inhibited by too much internal processing in any of these three modes. Acting can be enhanced by courageous initiative taking and the creation of cycles of goal setting and feedback to monitor performance. Action skills of initiative, goal setting, and action taking can aid in the development and expression of the acting mode of learning.

Mindful Experiential Learning

Mindfulness is one special form of meta-cognition that is especially effective for enhancing learning from experience. Mindfulness is an age old set of practices used to overcome the tendency to "sleep walk" automatically through our lives. In recent times these practices have been accepted into mainstream psychology, social psychology, and medicine. Empirical studies are now finding statistical support for what many have known for two millennia: that practicing mindfulness enhances mental and physical health, creativity, and contextual learning.

William James (1890), the originator of the theory of experience on which ELT is based, stated, "no state once gone can recur and be identical with what it was before" (p.155). The mind often neglects the rich context available for observation. Instead it automatically labels stimuli based on limited exposure and moves on to the next stimulus to under-observe. Labeling experiences as fun, boring, sad, happy, urgent, relaxed, and so on are also often based in automatically categorizing experience, rather than being fully present in the unique context of every moment. For James, everything begins and ends in the continuous flux and flow of experience. This emphasis on immediate direct sensual experience is exactly the focus on here and now experience that characterizes mindfulness. James emphasized the importance of attention, as he noted—"My experience is what I agree to attend to." (1890, p. 403). This also is a central element of mindfulness.

The practices of mindfulness are aimed at helping the individual: 1) focus on present and direct experience, 2) be intentionally aware and attentive and accept life as an emergent process of change. Our research on mindfulness and experiential learning (Yeganeh 2006, Yeganeh & Kolb 2009) suggests that the practice of mindfulness can help individuals learn from experience by enhancing presence and intentional attention.

To be present and engaged in direct experience, one must anchor in present-centered awareness by attending to the 5 senses. One of the strongest ways to attend to the present moment is through calm and aware breathing (Good & Yeganeh 2006, Yeganeh, 2006,

Yeganeh & Kolb, 2009). Attending to the present moment serves to quiet the mind; reducing automatic, habitual patterns of thinking and responding. Presence enhances Concrete Experience and allows the learning cycle to begin. In a sense, we cannot learn from experience if we do not first *have* an experience, and often, automatic routines make it difficult for direct experiencing in the moment to occur.

Intentional attention—the process of being aware and choiceful about what we are attending to—is, as James says, the process that creates our experience. Mindfulness becomes important when we consider *how* we choose to process and learn from the events in our lives. By intentionally guiding the learning process and paying attention to how we are going through the phases of the learning cycle, we make ourselves through learning. How and what we learn determines the way we process the possibilities of each new emerging experience, which in turn determines the range of choices and decisions we see. The choices and decisions we make to some extent determine the events we live through, and these events influence our future choices. Thus, we create ourselves through the choices of the actual occasions they live through. For many, this learning style choice is relatively unconscious, an auto-pilot program for learning. Mindfulness can put the control of our learning and our life back in our hands.

Deliberate Practice—Becoming an Expert Learner

We all know that learning involves repeated practice. However time spent practicing does not necessarily lead to learning and improved performance. Going to the golf practice range and hitting bucket after bucket of balls doesn't necessarily improve your game and in fact may make it worse by ingraining bad habits. Expert performance research initiated in the early 1990's by K. Anders Ericsson (Ericsson, Krampe & Tesch-Römer 1993; Ericsson & Charness 1994; Ericsson 2006; Baron & Henry 2010) teaches a great deal about learning from practice. The good news from this work is that greatness, for the most part, is not a function of innate talent; it is learned from experience. The not-so-good news is that it involves long term commitment (ten years or 10,000 hours for many top experts) and a particular kind of practice that is hard work, called deliberate practice.

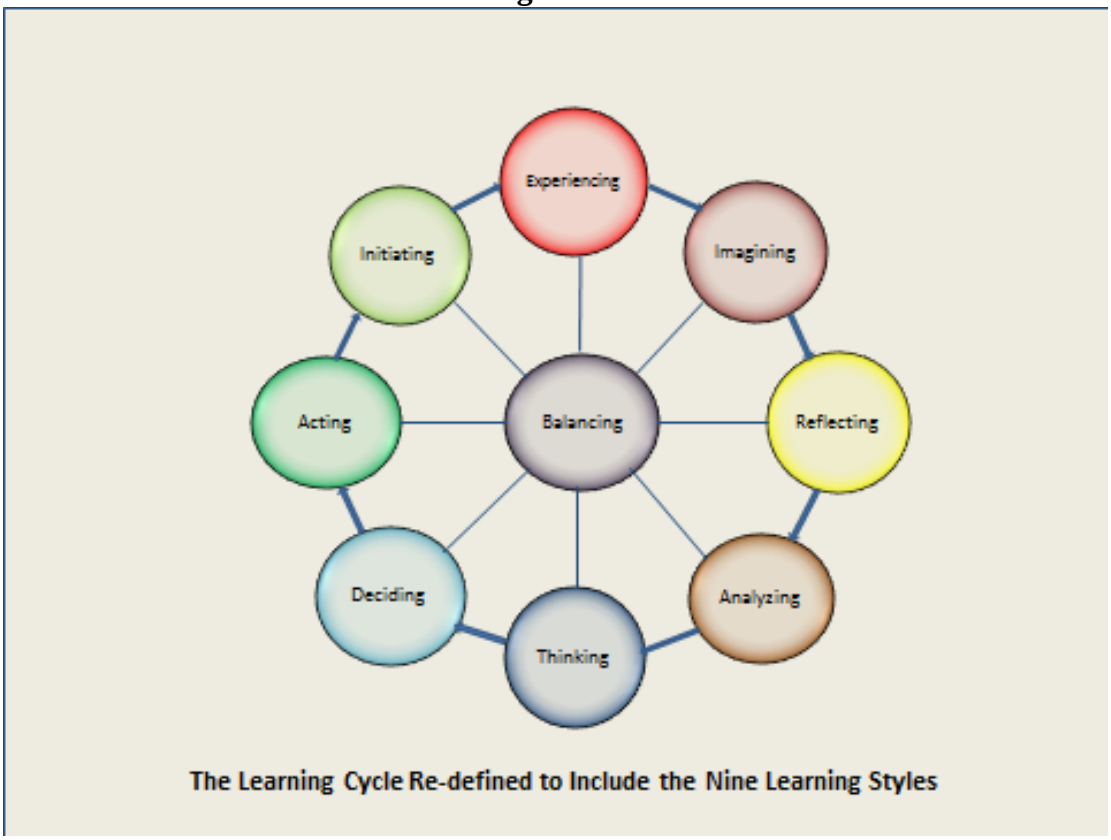
The basic techniques of deliberate practice are useful for improving our ability to learn from experience. Essentially deliberate practice involves intense concentrated, repeated performance that is compared against an ideal or "correct" model of the performance. It requires feedback that compares the actual performance against the ideal to identify "errors" that are corrected in subsequent performance attempts. In this sense deliberate practice can be seen as mindful experiential learning—focused reflection on a concrete performance experience that is analyzed against a meta-cognitive ideal model to improve future action in a recurring cycle of learning. Learning relationships can be of great help in deliberate practice by providing expert models, feedback and support for the focused effort required.

EDUCATOR ROLES AND TEACHING AROUND THE LEARNING CYCLE

The major implication of ELT for education is to design educational programs in a way that teaches around the learning cycle so that learners can use and develop all learning styles in a way that completes the learning cycle for them and promotes deep learning. Chapter seven includes numerous examples of programs that have been created in this way in many fields of study. Appendix 10 gives sample experiential learning designs that teach to all learning styles and Appendix 11 describes the Personal Application Assignment which was created as a way to holistically assess learning in a way that equally evaluates all learning modes.

In our interviews and observations of experienced, successful educators we find that they tend to "teach around the learning cycle" in this manner. They organize their educational activities in such a manner that they address all four learning modes—experiencing, reflecting, thinking, and acting. As they do this, they lead learners around the cycle; shifting the role they play depending on which stage of the cycle they are addressing. In effect the role they adopt helps to create a learning space designed to facilitate the transition from one learning style to the other as shown in Figure 11. Often they do this in a recursive fashion, repeating the cycle many times in a learning program. In effect the cycle becomes a spiral with each passage through the cycle deepening and extending learners' understanding of the subject.

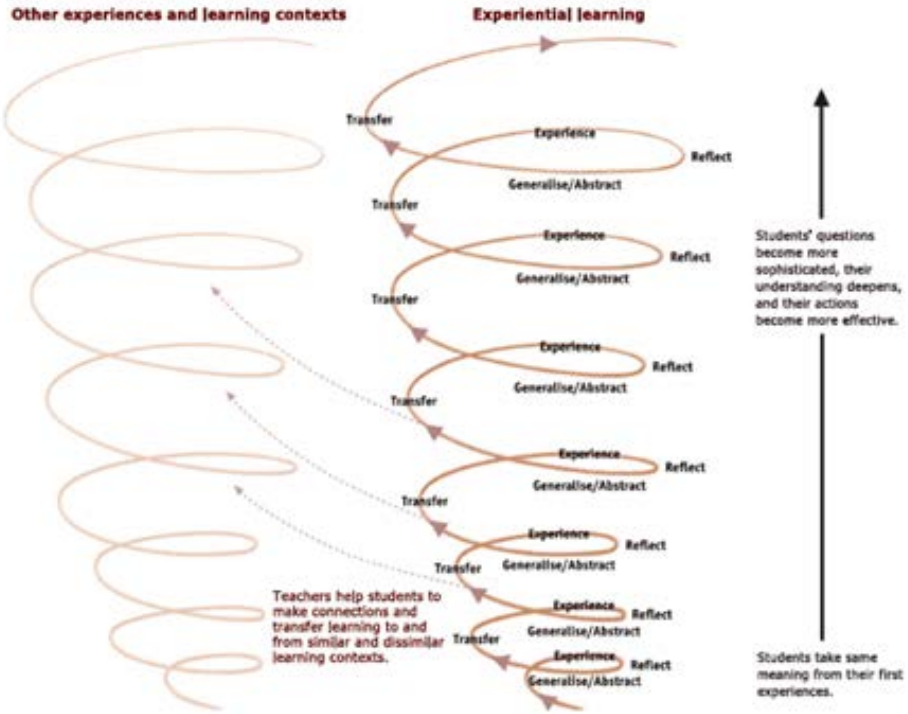
Figure 11



The Learning Cycle Re-defined to Include the Nine Learning Styles

When a concrete experience is enriched by reflection, given meaning by thinking and transformed by action the new experience created becomes richer, broader and deeper. Further iterations of the cycle continue the exploration and transfer to experiences in other contexts. The New Zealand Ministry of Education (2004) has used this spiraling learning process as the framework for the design of middle school curricula. Figure 12 describes how teachers use the learning spiral to promote higher level learning and to transfer knowledge to other contexts.

Figure 12. Teaching and the Learning Spiral



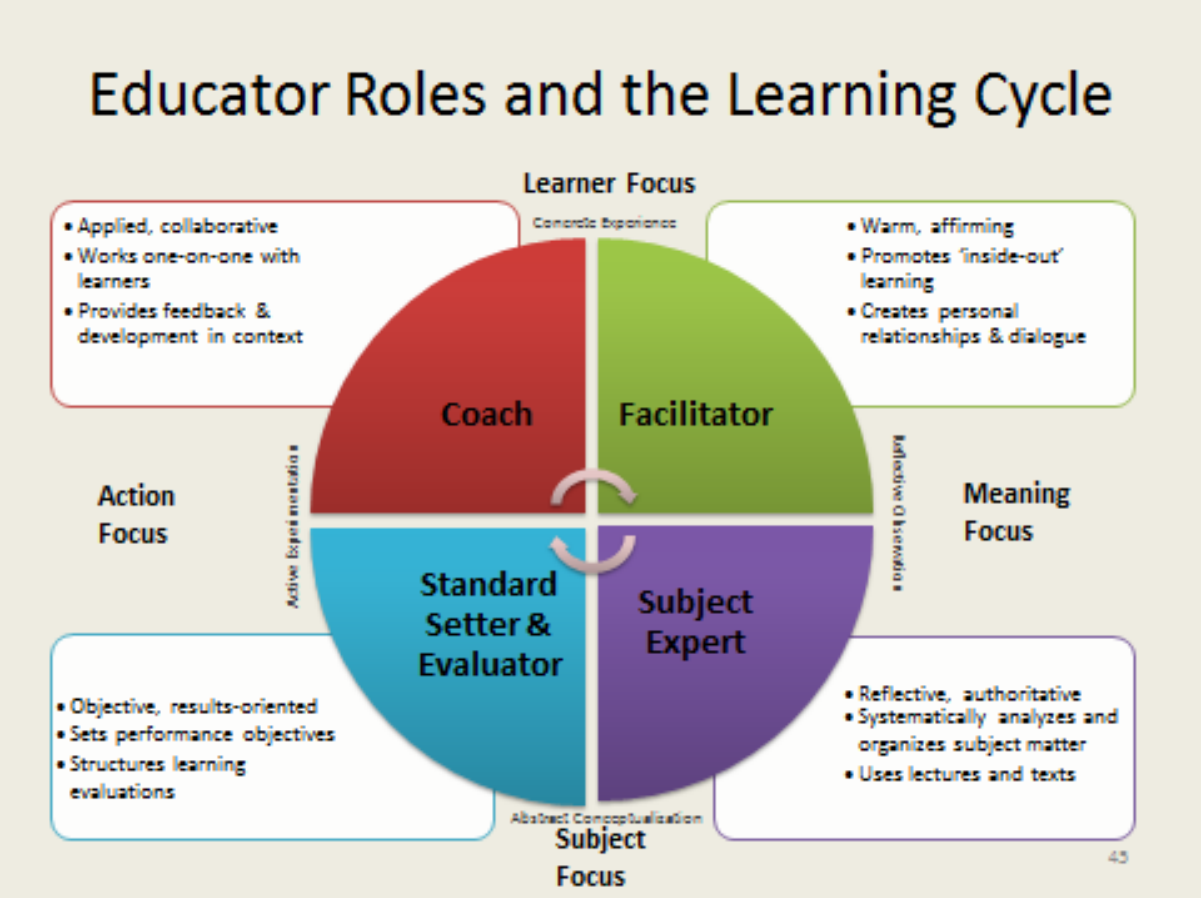
Educator Roles

Teaching around the learning cycle and to different learning styles introduces the need for adjustments in the role one takes with learners. The Educator Role Profile (Kolb & Kolb, 2011) was created to help educators understand their preferred teaching role and plan for how they can adapt to teaching around the learning cycle. The self-report instrument is based on the assumption that preferences for teaching roles emerge from a combination of beliefs about teaching and learning, goals for the educational process, preferred teaching style, and instructional practices. Educator roles are not limited to individuals in formal classroom teaching situations. The framework can be extended to individuals in all walks of life who "teach" as leaders, coaches, parents, friends, etc.

A teaching role is a patterned set of behaviors that emerge in response to the learning environment, including students and the learning task demands. Each teaching role engages

students to learn in a unique manner, using one mode of grasping experience and one mode of transforming experience. In the facilitator role, educators draw on the modes of concrete experience and reflective observation to help learners get in touch with their own experience and reflect on it. Subject matter experts, using the modes of reflective observation and abstract conceptualization, help learners organize and connect their reflection to the knowledge base of the subject matter. They may provide models or theories for learners to use in subsequent analysis. The standard setting and evaluating role uses abstract conceptualization and active experimentation to help students apply knowledge toward performance goals. In this role, educators closely monitor the quality of student performance toward the standards they set, and provide consistent feedback. Finally, those in the coaching role draw on concrete experience and active experimentation to help learners take action on personally meaningful goals. These roles can also be organized by their relative focus on the student versus the subject and action versus knowledge as illustrated in Figure 13.

Figure 13



The Educator Role Profile (ERP) describes four role positions—Facilitator, Expert, Evaluator and Coach. Educators play these roles as they help learners maximize learning by moving through the four stages of the experiential learning cycle.

- **The Facilitator Role.** When facilitating, educators help learners get in touch with their personal experience and reflect on it. They adopt a warm affirming style to draw out learners' interests, intrinsic motivation and self-knowledge. They often do this by facilitating conversation in small groups. They create personal relationships with learners.

- **The Expert Role.** In their role as subject expert, educators help learners organize and connect their reflections to the knowledge base of the subject matter. They adopt an authoritative, reflective style. They often teach by example, modeling and encouraging critical thinking as they systematically organize and analyze the subject matter knowledge. This knowledge is often communicated through lectures and texts.

- **The Evaluator Role.** As a standard setter and evaluator, educators help learners master the application of knowledge and skill in order to meet performance requirements. They adopt an objective results-oriented style as they set the knowledge requirements needed for quality performance. They create performance activities for learners to evaluate their learning.

- **The Coaching Role** In the coaching role, educators help learners apply knowledge to achieve their goals. They adopt a collaborative, encouraging style, often working one-on-one with individuals to help them learn from experiences in their life context. They assist in the creation of personal development plans and provide ways of getting feedback on performance.

Most of us adopt each of these roles to some extent in our educational and teaching activities. This is in part because these roles are determined by the way we resolve fundamental dilemmas of teaching. Do we focus on the learner's experience and interest or subject matter requirements? Do we focus on effective performance and action or on a deep understanding of the meaning of ideas? All are required for maximally effective learning. Individuals, however, tend to have a definite preference for one or two roles over the others; because of their educational philosophy, their personal teaching style, and the requirements of their particular educational setting including administrative mandates and learner needs. The ERP is designed to help you sharpen your awareness of these preferences and to make deliberate choices about what works best for you in your specific situation.

2. THE LEARNING STYLE INVENTORY

PURPOSE

The Kolb Learning Style inventory (KLSI) was created to fulfill two purposes:

1. To serve as an educational tool to increase individuals' understanding of the process of learning from experience and their unique individual approach to learning. By increasing awareness of how they learn, the aim is to increase learners' capacity for meta-cognitive control of their learning process; enabling them to monitor and select learning approaches that work best for them in different learning situations. By providing a language for talking about learning styles and the learning process the inventory can foster conversation among learners and educators about how to create the most effective learning environment for those involved. For this purpose the inventory is best presented, not as a test, but as an experience in understanding how you learn. Scores on the inventory should not be interpreted as definitive, but as a starting point for exploration of how one learns best. To facilitate this purpose a self-scoring and interpretation book that explains the experiential learning cycle and the characteristics of the different learning styles along with scoring and profiling instructions is included with the inventory.

2. To provide a research tool for investigating experiential learning theory (ELT) and the characteristics of individual learning styles. This research can contribute to the broad advancement of experiential learning and specifically to the validity of interpretations of individual learning style scores. A research version of the instrument including only the inventory to be scored by the researcher is available for this purpose.

The KLSI is not a criterion-referenced test and is not intended for use to predict behavior for purposes of selection, placement, job assignment, or selective treatment. This includes not using the instrument to assign learners to different educational treatments, a process sometimes referred to as "tracking". Such categorizations based on a single test score amounts to stereotyping that runs counter to the philosophy of experiential learning that emphasizes individual uniqueness. "When it is used in the simple, straightforward, and open way intended, the LSI usually provides a valuable self-examination and discussion that recognizes the uniqueness, complexity and variability in individual approaches to learning. The danger lies in the reification of learning styles into fixed traits, such that learning styles become stereotypes used to pigeonhole individuals and their behavior." (Kolb, 1981: 290-291)

The KLSI is constructed as a self-assessment exercise and tool for construct validation of ELT. Tests designed for predictive validity typically begin with a criterion like academic achievement and work backward to identify items or tests with high criterion correlations. Even so, even the most sophisticated of these tests rarely rises above a .5 correlation with the criterion. For example, while Graduate Record

Examination Subject Test scores are better predictors of first-year graduate school grades than either the General Test score or undergraduate GPA, the combination of these three measures only produces multiple correlations with grades ranging from .4 to .6 in various fields (Anastasi & Urbina, 1997).

Construct validation is not focused on an outcome criterion, but on the theory or construct the test measures. Here the emphasis is on the pattern of convergent and discriminant theoretical predictions made by the theory. Failure to confirm predictions calls into question the test and the theory. "However, even if each of the correlations proved to be quite low, their cumulative effect would be to support the validity of the test and the underlying theory." (Selltiz, Jahoda, Deutsch, & Cook, 1960, p. 160) Judged by the standards of construct validity ELT has been widely accepted as a useful framework for learning centered educational innovation, including instructional design, curriculum development, and life-long learning. Field and job classification studies viewed as a whole also show a pattern of results consistent with the ELT structure of knowledge theory.

HISTORY

There have been five versions of the Learning Style Inventory published over the last 35 years. Through this time attempts have been made to openly share information about the inventory, its scoring, and technical characteristics with other interested researchers. The results of their research have been instrumental in the continuous improvement of the inventory.

Learning Style Inventory—Version 1 (Kolb 1971, Kolb 1976).

The original Learning Style Inventory (LSI 1) was created in 1969 as part of a MIT curriculum development project that resulted in the first management textbook based on experiential learning (Kolb, Rubin and McIntyre 1971). It was originally developed as an experiential educational exercise designed to help learners understand the process of experiential learning and their unique individual style of learning from experience. The term “learning style” was coined to describe these individual differences in how people learn.

Items for the inventory were selected from a longer list of words and phrases developed for each learning mode by a panel of four behavioral scientists familiar with experiential learning theory. This list was given to a group of 20 graduate students asking them to rate each word or phrase for social desirability. Attempting to select words that were of equal social desirability, a final set of 12 items including a word or phrase for each learning mode was selected for pre-testing. Analysis showed that 3 of these sets produced nearly random responses and were thus eliminated resulting in a final version of the LSI with 9 items. These items were further refined through item-whole correlation analysis to include six scored items for each learning mode.

Research with the inventory was stimulated by classroom discussions with students who found the LSI to be helpful to them in understanding the process of experiential learning and how they learn. From 1971 until it was revised in 1985 there were over 350 published research studies using the LSI. Validity for the LSI 1 was established in a number of fields including education, management, psychology, computer science, medicine, and nursing (Hickcox 1990, Iliff 1994). The results of this research with LSI 1 provided provided empirical support for the most complete and systematic statement of ELT, *Experiential Learning: Experience as the Source of Learning and Development* (Kolb 1984). There were several studies of the LSI 1 that identified psychometric weaknesses of the instrument, particularly low internal consistency reliability and test-retest reliability.

Learning Style Inventory—Version 2 (Kolb 1985)

Low reliability coefficients and other concerns about the LSI 1 led to a revision of the inventory in 1985 (LSI 2). Six new items chosen to increase internal reliability (alpha) were added to each scale making 12 scored items on each scale. These changes increased scale alphas to an average of .81 ranging from .73 to .88. Wording of all items was simplified to a 7^{th} grade reading level and the format was changed to include sentence stems (e.g. "When I learn"). Correlations between the LSI 1 and LSI 2 scales averaged .91 and ranged from .87 to .93. A new more diverse normative reference group of 1446 men and women was created.

Research with the LSI 2 continued to establish validity for the instrument. From 1985 until the publication of the LSI 3 1999 over 630 studies were published most using the LSI 2. While internal reliability estimates for the LSI 2 remained high in independent studies, test-retest reliability remained low.

Learning Style Inventory—Version 2a (Kolb 1993).

In 1991 Veres, Sims and Locklear published a reliability study of a randomized version of the LSI 2 that showed a small decrease in internal reliability but a dramatic increase in test-retest reliability with the random scoring format. To study this format a research version of the random format inventory (LSI 2a) was published in 1993.

Kolb Learning Style Inventory—Version 3 (Kolb 1999).

In 1999 the randomized format was adopted in a revised self scoring and interpretation booklet (LSI 3) that included a color-coded scoring sheet to simplify scoring. The new booklet was organized to follow the learning cycle emphasizing the LSI as an "experience in learning how you learn". New application information on teamwork, managing conflict, personal and professional communication and career choice and development were added. The LSI 3 continued to use the LSI 2 normative reference group until norms for the randomized version could be created.

Kolb Learning Style Inventory—Version 3.1 (Kolb 2005)

The KLSI 3.1 modified the LSI 3 to include a new normative data sample of 6977 LSI users. The format, items, scoring and interpretative booklet remain identical with KLSI 3. The only change in the KLSI 3.1 is in the norm charts used to convert raw LSI scores.

Kolb Learning Style Inventory—Version 3.2 (Kolb and Kolb 2013)

The KLSI 3.2 was created in 2013 to incorporate the new nine learning style typology of the KLSI 4.0 in a paper version. The instrument and normative sample are identical to the KLSI 3.1. The self-scoring and Interpretation booklet was changed to explain the nine learning styles and their application to problem solving, relationships, etc..

Kolb Learning Style Inventory—Version 4.0 (Kolb and Kolb 2011)

The Kolb Learning Style Inventory 4.0 is the first major revision of the KLSI since 1999 and the third since the original LSI was published in 1971. Based on many years of research involving scholars around the world and data from many thousands of respondents, the KLSI 4.0 includes four major additions:

A new 9 Learning Style Typology. Data from empirical and clinical studies over the years has shown that the original 4 learning style types—Accommodating, Assimilating , Converging and Diverging— can be refined further into a 9 style typology that better defines the unique patterns of individual learning styles and reduces the confusions introduced by borderline cases in the old 4 style typology. The new nine styles are Initiating, Experiencing, Imagining, Reflecting, Analyzing, Thinking, Deciding, Acting and Balancing.

Assessment of Learning Flexibility. The experiential learning styles are not fixed traits but dynamic states that can "flex" to meet the demands of different learning situations. For the first time the KLSI 4.0 includes a personal assessment of the degree to which a person changes their style in different learning contexts. The flexibility score also shows which learning style types the individual uses in addition to their dominant learning style type. This information can help individuals improve their ability to move freely around the learning cycle and improve their learning effectiveness.

An Expanded Personal Report Focused on Improving Learning Effectiveness. The new personal interpretative report has been redesigned to focus on improving personal learning effectiveness based on a detailed profile of how the person prefers to learn and their learning strength and weaknesses. It helps learners take charge of their learningwith a planning guide for learning and tips for application in work and personal life.

Improved Psychometrics. This revision includes new norms that are based on a larger, more diverse and representative sample of 10423 LSI users. The KLSI 4.0 maintains the high scale reliability of the KLSI 3.1 while offering higher internal validity.

Score on the KLSI 4.0 are highly correlated with scores on the previous KLSI 3.1 thus maintaining the external validity that the instrument has shown over the years.

Due to the complexity of scoring learning flexibility, the KLSI 4.0 is only available in an online version.

FORMAT

The KLSI is designed to measure the degree to which individuals display the different learning styles derived from experiential learning theory. The form of the inventory is determined by three design parameters. First, the test is brief and straightforward, making it useful both for research and for discussing the learning process with individuals and providing feedback. Second, the test is constructed in such a way that individuals respond to it as they would respond to a learning situation: it requires them to resolve the tensions between the abstract-concrete an active-reflective orientations. For this reason, the LSI format requires them to rank order their preferences for the abstract, concrete, active and reflective orientations. Third, and most obviously, it was hoped that the measures of learning styles would predict behavior in a way consistent with the theory of experiential learning.

All versions of the KLSI have had the same format—a short questionnaire (9 items for LSI 1 and 12 items for subsequent versions) that asks respondents to rank four sentence endings that correspond to the four learning modes – Concrete Experience (e.g., experiencing), Reflective Observation (reflecting), Abstract Conceptualization (thinking), and Active Experimentation (doing). Items in the LSI are geared to a 7th grade reading level. The inventory is intended for use by teens and adults. It is not intended for use by younger children. The LSI has been translated into many languages, including, Arabic, Chinese, French, Japanese, Italian, Portuguese, Spanish, Swedish and Thai; and there have been many cross cultural studies using it (Yamazaki 2002).

The Forced-choice Format of the KLSI

The format of the KLSI is a forced choice format that ranks an individual's relative choice preferences among the four modes of the learning cycle. This is in contrast the more common normative or free choice format, such as the widely used Likert scale, that rates absolute preferences on independent dimensions. The forced choice format of the LSI was dictated by the theory of experiential learning and by the primary purpose of the instrument.

ELT is a holistic, dynamic and dialectic theory of learning. Because it is holistic the four modes that comprise the experiential learning cycle, CE, RO, AC, and AE are conceived as interdependent. Learning involves resolving the creative tension among these learning modes in response to the specific learning situation. Since the two learning dimensions, AC-CE and AE-RO are related dialectically, the choice of one pole involves not choosing the opposite pole. Therefore, because ELT postulates that learning in life situations requires the resolution of conflicts among interdependent learning modes; to be ecologically valid the

learning style assessment process should require a similar process of conflict resolution in the choice of ones preferred learning approach.

ELT defines learning style not as a fixed trait, but a dynamic state arising from an individual's preferential resolution of the dual dialectics of experiencing/ conceptualizing and acting/reflecting. "The stability and endurance of these states in individuals comes not solely from fixed genetic qualities or characteristics of human beings: nor, for that matter, does it come from the stable fixed demands of environmental circumstances. Rather, stable and enduring patterns of human individuality arise from consistent patterns of transaction between the individual and his or her environment…The way we process the possibilities of each new emerging event determines the range of choices and decisions we see. The choices and decisions we make to some extent determine the events we live through, and these events influence our future choices. Thus, people create themselves through the choice of actual occasions they live through." (Kolb 1984: 63-64)

The primary purpose of the KLSI is to provide learners with information about their preferred approach to learning. The most relevant information for the learner is about intra-individual differences, his or her relative preference for the four learning modes, not inter-individual comparisons. Ranking relative preferences among the four modes in a forced choice format is the most direct way to provide this information. While individuals who take the inventory sometimes report difficulty in making these ranking choices, they report that the feedback they get from the LSI gives them more insight than has been the case when we use a normative Likert rating scale version. This is because the social desirability response bias in the rating scales fails to define a clear learning style, i.e. they say they prefer all learning modes. This is supported by Harland's (2002) finding that feedback from a forced choice test format was perceived as more accurate, valuable and useful than feedback from a normative version.

The adoption of the forced choice method for the KLSI has at times placed it in the center of an ongoing debate in the research literature about the merits of forced choice instruments between what might be called "rigorous statisticians" and "pragmatic empiricists". Statisticians have questioned the use of the forced choice format because of statistical limitations, called ipsativity, that are the result of the ranking procedure. Since ipsative scores represent the relative strength of a variable compared to others in the ranked set the resulting dependence among scores produces method induced negative correlations among variables and violates a fundamental assumption of classical test theory required for use of techniques such as analysis of variance and factor analysis—independence of error variance. Cornwell and Dunlap (1994) stated that ipsative scores cannot be factored and that correlation-based analysis of ipsative data produced uninterpretable and invalid results (c.f. Hicks 1970, Johnson et al. 1988). Other criticisms include the point that ipsative scores are technically ordinal, not the interval scales required for parametric statistical analysis; that they produce lower internal reliability estimates and lower validity coefficients (Barron 1996). While critics of forced choice instruments acknowledge that these criticisms do not take away from the validity of intra-individual comparisons (KLSI purpose one), they argue that ipsative scores are not appropriate for inter-individual comparisons since inter-individual comparisons on a ranked variable are not independent absolute preferences but preferences that are relative to the other ranked variables in the set (Barron 1996, Karpatschof and Elkjaer 2000). However, since ELT argues that a given learning mode preference is relative

to the other three modes, it is the comparison of relative not absolute preferences that the theory seeks to assess.

The "pragmatic empiricists" argue that in spite of theoretical statistical arguments, normative and forced choice variations of the same instrument can produce empirically comparable results. Karpatschof and Elkjaer (2000) advance this case in their metaphorically titled paper "Yet the Bumblebee Flies". With theory, simulation and empirical data they present evidence for the comparability of ipsative and normative data. Saville and Wilson (1991) found a high correspondence between ipsative and normative scores when forced choice involved a large number of alternative dimensions.

Normative tests also have serious limitations which the forced choice format was originally created to deal with (Sisson 1948). Normative scales are subject to numerous response biases—central tendency bias where respondents avoid extreme responses, acquiescence response, and social desirability responding—and are easy to fake. Forced choice instruments are designed to avoid these biases by forcing choice among alternatives in a way that reflects real live choice making (Hicks 1970, Barron 1996). Matthews and Oddy found large bias in the extremeness of positive and negative responses in normative tests and conclude that when sources of artifact are controlled "individual differences in ipsative scores can be used to rank individuals meaningfully" (1997: 179). Pickworth and Shoeman (2000) found significant response bias in two normative LSI formats developed by Marshall and Merritt (1986) and Geiger et al. (1993). Conversely, Beutell and Kressel (1984) found that social desirability contributed less that 4% of the variance in LSI scores in spite of the fact that individual LSI items all had very high social desirability.

In addition, ipsative tests can provide external validity evidence comparable to normative data (Barron 1996) or in some cases even better (Hicks 1970). For example, attempts to use normative rating versions of the LSI report reliability and internal validity data but little or no external validity (Pickworth and Shoeman 2000, Geiger et al. 1993, Romero et al. 1992, Marshall and Merrit 1986, Merrit and Marshall 1984).

Characteristics of the KLSI Scales.

The KLSI assesses six variables, four primary scores that measure an individual's relative emphasis on the four learning orientations –Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE) and two combination scores measure an individual's preference for abstractness over concreteness (AC-CE) and action over reflection (AE-RO). The four primary scales of the LSI are ipsative because of the forced choice format of the instrument. This results in negative correlations among the four scales the mean magnitude of which can be estimated (assuming no underlying correlations among them) by the formula $-1/(m-1)$ where m is the number of variables (Johnson et al. 1988). This results in a predicted average method induced correlation of -.33 among the four primary LSI scales.

The combination scores AC-CE and AE-RO, however, are not ipsative. Forced choice instruments can produce scales which are not ipsative (Hicks 1970, Pathi, Manning and Kolb 1989). To demonstrate the independence of the combination scores and

interdependence of the primary scores, Pathi, Manning and Kolb (1989) had SPSS-X randomly fill out and analyze 1000 LSI's according to the ranking instructions. While the mean inter-correlation among the primary scales was -.33 as predicted; the correlation between AC-CE and AE-RO was +.038.

In addition, if AC-CE and AE-RO were ipsative scales the correlation between the two scales would be -1.0 according to the above formula. Observed empirical relationships are always much smaller, e.g. +.13 for a sample of 1591 graduate students (Freedman and Stumpf 1978), -.09 for the LSI 2 normative sample of 1446 respondents (Kolb 1999b), -.19 for a sample of 1296 MBA students (Boyatzis and Mainemelis 2000) and -.21 for the normative sample of 6977 LSI for the KLSI 3.1 described below.

The independence of the two combination scores can be seen by examining some example scoring results. For example, when AC-CE or AE-RO on a given item takes a value of +2 (from, say, AC = 4 and CE = 2 or AC = 3 and CE = 1) the other score can take a value of +2 or -2. Similarly when either score takes a value of +1 (from 4 -3, 3-2 or 2-1) the other can take the values of +3, +1, -1, or -3. In other words, when AC-CE takes a particular value, AE-RO can take two to four different values, and the score on one dimension does not determine the score on the other.

In the KLSI 3.2 we introduce two new non-ipsative continuous combination scores in addition to the primary learning cycle dialectics of AC-CE and AE-RO. These scores assess the combination dialectics of Assimilation – Accommodation and Converging – Diverging assessed by the four learning style types in the KLSI 3.1:

Assimilation - Accommodation = (AC+RO) - (AE+CE)

A high score on this dimension indicates a learning preference for assimilation or generalized, conceptual learning, while a low score indicates a learning preference for accommodation or active contextual learning. The concepts of assimilation and accommodation are central to Piaget's (1952) definition of intelligence as the balance of adapting concepts to fit the external world (accommodation) and the process of fitting observations of the external world into existing concepts (assimilation). This measure was used in the validation of the Learning Flexibility Index (Sharma & Kolb 2010—see chapter 6) and has been used by other researchers in previous studies (Wiersta, and de Jong 2002, Allison and Hayes 1996).

Converging – Diverging = (AC+AE) – (CE+RO)

A high score on this dimension indicates a learning preference for converging or evaluative decision making that closes down on the best solution to a problem versus diverging to open up new imaginative possibilities and alternatives. The concepts of converging and diverging originated in Guilford's (1988) structure of intellect model as the central dialectic of the creative process. This dialectic concept has been used in research on ELT by Gemmell (2012) and Kolb (1983).

Continuous Balance Scores

Some studies have used continuous balance scores for ACCE and AERO to assess balanced learning style scores (Mainemelis, Boyatzis and Kolb 2002, Sharma and Kolb 2010). These variables compute the absolute values of the ACCE and AERO scores adjusted to center on the 50^{th} percentile of the normative comparison group, in this case the KLSI 3.1.

BALANCE ACCE = ABS [AC – (CE + 7)]

BALANCE AERO = ABS [AE – (RO + 6)]

3. NORMS FOR THE KLSI VERSION 3.1 & 3.2

Norms for the KLSI 3.1 & 3.2 were created from responses by several groups of users who completed the randomized LSI 3. These norms are used to convert LSI raw scale scores to percentile scores (See Appendix 1). The purpose of percentile conversions is to achieve scale comparability among an individual's LSI scores (Barron 1996) and to define cut-points for defining the learning style types. Table 2 shows the means and standard deviations for KLSI scale scores for the normative groups.

Table 2. KLSI 3.1 & 3.2 Scores for Normative Groups

SAMPLE	N		CE	RO	AC	AE	AC-CE	AE-RO
TOTAL	6977	MN.	25.39	28.19	32.22	34.14	6.83	5.96
NORM		S.D.	*6.43*	*7.07*	*7.29*	*6.68*	*11.69*	*11.63*
GROUP								
On-line	5023		25.22	27.98	32.43	34.36	7.21	6.38
Users			*6.34*	*7.03*	*7.32*	*6.65*	*11.64*	*11.61*
Research	288		23.81	29.82	33.49	32.89	9.68	3.07
Univ.			*6.06*	*6.71*	*6.91*	*6.36*	*10.91*	*10.99*
freshmen								
Lib. Arts	221		24.51	28.25	32.07	35.05	7.56	6.80
College			*6.39*	*7.32*	*6.22*	*7.08*	*10.34*	*12.37*
students								
Art	813		28.02	29.51	29.06	33.17	1.00	3.73
College			*6.61*	*7.18*	*6.94*	*6.52*	*11.13*	*11.49*
UG								
Research	328		25.54	26.98	33.92	33.48	8.38	6.49
Univ.			*6.44*	*6.94*	*7.37*	*7.06*	*11.77*	*11.92*
MBA								
Distance	304		23.26	27.64	34.36	34.18	11.10	6.54
E-learning			*5.73*	*7.04*	*6.87*	*6.28*	*10.45*	*11.00*
Adult UG								

TOTAL NORMATIVE GROUP

Normative percentile scores for the LSI 3.1& 3.2 are based on a total sample of 6977 valid KLSI scores from users of the instrument. This user norm group is composed of 50.4% women and 49.4% men. Their ages range from 17-75 broken down into the following age range groups—< 19 = 9.8%, 19-24 = 17.1%, 25-34 = 27%, 35-44 = 23%, 45-54 = 17.2% & >54 = 5.8 %. Their educational level is as follows—primary school graduate = 1.2%, secondary school degree= 32.1%. university degree= 41.4% and post graduate degree =25.3%. The sample includes college students and working adults in a wide variety of fields. It is made up primarily of US residents (80%) with the remaining 20% of users residing in 64 different countries. The norm group is made up of six subgroups the specific demographic characteristics of which are described below:

On-line users.

This sample of 5023 is composed of individuals and groups who have signed up to take the LSI on line. Group users include undergraduate and graduate student groups, adult learners, business management groups, military management groups and other organizational groups. Half of the sample are men and half are women. Their ages range as follows--<19 = .2%, 19-24 = 10.1%, 25-34 = 29.6%, 35-44 = 28.8%, 45-54 = 23/1%, >55 = 8.1 %. Their educational level is as follows—primary school graduate = 1.7%, secondary school degree = 18.2%. university degree = 45.5% and post graduate degree = 34.6%. Most of the on-line users (66%) reside in the US with the remaining 34% living in 64 different countries with the largest representations from Canada (317), U. K. (212), India (154), Germany (100), Brazil (75), Singapore (59), France (49) and Japan (42).

Research university freshmen.

This sample is composed of 288 entering freshmen at a top research university. 53% are men and 47% are women. All are between the ages of 17 & 22. Over 87% of these students intend to major in science or engineering.

Liberal arts college students.

Data for this sample was provided by Kayes (2006). It includes 221 students (182 undergraduates and 39 part time graduate students) enrolled in business courses at a private liberal arts college. Their average age was 22 ranging from 18-51. 52% were male and 48% were female.

Art college undergraduates.

This sample is composed of 813 freshmen and graduating students from three undergraduate art colleges. Half of the sample are men and half are women. Their average age is 20 distributed as follows--<19 =42.7%, 19-24 = 54.3%, 25-34 = 2%, >35 = 1%.

Research university MBA students.

This sample is composed of 328 full time (71%) and part time (29%) MBA students in a research university management school. 63% are men and 37% women. Their average age is 27 distributed as follows—19-24 = 4.1%, 25-34 = 81.3%, 35-44 = 13.8%, 45-54 = 1%.

Distance e-learning adult undergraduate students.

This sample is composed of 304 adult learners enrolled in an e-learning distance education undergraduate degree program at a large state university. 56% were women and 44% men. There average age is 36 distributed as follows—19-24 = 6.3%, 25-34 = 37.5%, 35-44 = 40.1 %, 45-54 = 14.5% & > 55 = 1.6%.

CUT-POINTS FOR LEARNING STYLE TYPES 3.1 VERSION

The four basic learning style types—Accommodating, Diverging, Assimilating, and Converging—are created by dividing the AC-CE and AE-RO scores at the 50th percentile of the total norm group and plotting them on the Learning Style Type Grid (Kolb 1999a:6). The cut point for the AC-CE scale is +7 and the cut point for the AE-RO scale is +6. The Accommodating type would be defined by an AC-CE raw score <=7 and an AE-RO score >=7, the Diverging type by AC-CE <=7 and AE-RO <=6, the Converging type by AC-CE >=8 and AE-RO >=7 and the Assimilating type by AC-CE >=8 and AE-RO <=6.

CUT-POINTS FOR LEARNING STYLE TYPES 3.2 VERSION

Recent theoretical and empirical work is showing that the original four learning styles can be refined to show nine distinct styles (Eickmann, Kolb & Kolb 2004, Kolb & Kolb 2005a, Boyatzis & Mainemelis 2000). David Hunt and his associates (Abby, Hunt and Weiser 1985, Hunt 1987) identified four additional learning styles which they identified as Northerner, Easterner, Southerner, and Westerner. In addition a Balancing learning style has been identified by Mainemelis, Boyatzis and Kolb (2002) that integrates AC and CE and AE and RO. These nine learning styles can be defined by placing them on the Learning Style Type Grid. Instead of dividing the grid at the 50th percentiles of the LSI normative distributions for AC-CE and AE-RO, the nine styles are defined by dividing the two normative distributions into thirds. On the AE-RO dimension the active regions are defined by percentiles greater than 66.67% (raw scores > 11) while the reflective regions are defined by percentiles less than 33.33% (< 1). On the AC-CE dimension the concrete regions are defined by < 2 and the abstract regions by> 12. For example the NW Initiating region would be defined by AC-CE raw scores <2 and AE-RO scores >11. (See Kolb and Kolb 2005a for examples and details.)

Initiating—ACCE < 2, AERO > 11
Experiencing—ACCE < 2, AERO > 0 & < 12
Imagining—ACCE < 2, AERO < 1
Reflecting—ACCE > 1 & < 13, AERO < 1
Analyzing—ACCE > 12, AERO < 1
Thinking—ACCE > 12, AERO > 0 & < 12
Deciding—ACCE > 12, AERO > 11
Acting—ACCE > 1 & < 13, AERO > 11
Balancing—ACCE > 1 & < 13, AERO > 0 & < 12

These cut-points using the norms of the KLSI 3.1 replicate the style types of the KLSI 4.0 which uses a new normative sample and as a result has slightly different cut-points.

4. RELIABILITY OF THE KLSI 3.1 & 3.2

This section reports internal consistency reliability studies using Cronbach's alpha and test-retest reliability studies for the randomized KLSI 3.1.

INTERNAL CONSISTENCY RELIABILITY

Table 3 reports Cronbach's alpha coefficients for 7 different studies of the randomized KLSI 3.1; the norm sub-sample of online LSI users, Kayes (2005) study of liberal arts college students, Wierstra and DeJong's (2002) study of psychology undergraduates, Veres et al. (1991) initial and replication studies of business employees and students and two studies by Ruble and Stout (1990, 1991) of business students. Wierstra and DeJong and Ruble and Stout used an LSI randomized in a different order than the KLSI 3.1. These results suggest that the KLSI 3.1 scales show good internal consistency reliability across a number of different populations.

Table 3. Internal Consistency Alphas for the Scale Scores of the KLSI 3.1

Source	N	CE	RO	AC	AE	AC-CE	AE-RO
ONLINE SAMPLE	5023	.77	.81	.84	.80	.82	.82
Kayes (2005)	221	.81	.78	.83	.84	.77	.84
Wierstra & DeJong (2002)	101	.81	.78	.83	.84	.83	.82
Veres *et.al.* (1991)*	711 Initial 1042 Rep.	.56 .67	.67 .67	.71 .74	.52 .58	-- --	-- --
Ruble and Stout	323 (1990) 403 (1991)	.72 .67	.75 .78	.72 .78	.73 .78	-- --	-- --

*Alpha coefficients are the average of three repeated administrations. Alphas for the initial administration were higher (average = .70).

TEST-RETEST RELIABILITY

Two test-retest reliability studies of the randomized format KLSI 3.1 have been published. Veres et al. (1991) administered the LSI three times at 8 week intervals to initial (N = 711) and replication (N =1042) groups of business employees and students and found test-retest correlations well above .9 in all cases. Kappa coefficients indicated that very few students changed their learning style type from administration to administration (See Table 4). Ruble and Stout (1991) administered the LSI twice to 253 undergraduate and graduate business students and found test-retest reliabilities that averaged .54 for the six LSI scales. A Kappa coefficient of .36 indicated that 47% of students changed their learning style classification on re-test. In these studies test-retest correlation coefficients range from moderate to excellent. The discrepancy between the studies is difficult to explain, although

ELT hypothesizes that learning style is situational, varying in response to environmental demands. Changes in style may be the result of discontinuous intervening experiences between test and retest (Kolb 1981) or individuals' ability to adapt their style to changing environmental demands (Mainemelis, Boyatzis and Kolb 2002, Jones, Reichard, and Mokhtari 2003).

Table 4. Test-Retest Reliability for the KLSI 3.1 (Veres *et.al* 1991)

	LSI Scales											
	Concrete			Reflective			Abstract			Active		
Time	1	2	3	1	2	3	1	2	3	1	2	3
					Initial Samples (N=711)							
1	-	.95	.92	-	.96	.93	-	.97	.94	-	.95	.91
2		-	.96		-	.97		-	.97		-	.96
3-												
					Replication Sample (N=1042)							
1	-	.98	.97	-	.98	.97	-	.99	.97	-	.98	.96
2		-	.99		-	.98		-	.99		-	.99
3												

Data source: Veres et al. (1991). Reproduced with permission. Time between tests was 8 weeks
Note: Kappa coefficients for the initial sample were .81 for Time 1-Time2, .71 for time 1-Time 3 and .86 for Time 2-Time 3. These results indicate that very few subjects changed their learning style classification from one administration to another.

Table 5. Test-retest Reliability for KLSI 3.1 (Ruble and Stout 1991)

Sample	N	CE	RO	AC	AE	AC-CE	AE-RO
UG&Grad business majors	253	.37	.59	.61	.58	.48	.60

LSI was randomized but in different order than KLSI 3.1. Time between tests was 5 weeks. Kappa coefficient was .36 placing 53% of respondents in the same category on retest.

5. VALIDITY

This section begins with an overview of validity research on the LSI 1 and LSI 2 from 1971 to the introduction of the KLSI 3 in 1999. It is followed by internal validity evidence for the KLSI 3 normative group including correlation and factor analysis studies of the LSI scales. The final part is focused on external validity evidence for the KLSI 3nd other LSI versions. It begins with demographic relationships of learning style with age, gender and educational level. This is followed by evidence for the relationship between learning style and educational specialization. Concurrent validity studies of relationships between learning style and other experiential learning assessment inventories are then presented followed by studies relating learning style to performance on aptitude tests and academic performance. Next research on ELT and learning style in teams is presented. The final part presents evidence for the practical utility of ELT and the LSI in the design and conduct of education in different disciplines in higher education.

AN OVERVIEW OF RESEARCH ON ELT AND THE LSI: 1971-1999

Since ELT is a holistic theory of learning that identifies learning style differences among different academic specialties, it is not surprising to see that ELT/LSI research is highly interdisciplinary, addressing learning and educational issues in several fields. Since the first publications in 1971 (Kolb, 1971; Kolb, Rubin & McIntyre, 1971) there have been many studies on ELT using the LSI 1 and LSI 2. The 1999 Bibliography of Research on Experiential Learning Theory and The Learning Style Inventory (Kolb & Kolb, 1999) included 1004 entries.

Table 6 shows the distribution of these studies by field and publication period. The field classification categories are: Education (including k-12, higher education, and adult learning), Management, Computer/Information Science, Psychology, Medicine, Nursing, Accounting, and Law. Studies were also classified as early (1971-1984) or recent (1985-1999). The division makes sense in that the most comprehensive statement of ELT, Experiential Learning, was published in 1984, and the original LSI was first revised in 1985.

Table 6. Early and Recent ELT/LSI Research by Academic Field and Publication.

ELT/LSI Research	Early Period (1971-1984)	Recent Period (1985-1999)	Total (1971-1999)
By Academic Field			
Education	165	265	430
Management	74	133	207
Computer Science	44	60	104
Psychology	23	78	101
Medicine	28	44	72
Nursing	12	51	63
Accounting	7	15	22
Law	1	4	5
Total	354	650	1004
By Publication Type			
Journal Articles	157	385	542
Doctoral Dissertations	76	133	209
Books & Chapters	43	58	101
Other	78	74	152
Total	354	650	1004

Data Source: Kolb & Kolb, 1999.

Table 6 also shows the distribution of the 1004 studies according to the publication type. More than 50% of the studies were published in journals and another approximately 20% were doctoral dissertations. 10% of the studies were either books or book chapters, and the remaining 150 studies were conference presentations, technical manuals, working papers, and master theses. Numbers should be considered approximate since a few recent citations have yet to be verified by abstract or full text. Also, classification by field is not easy because many studies are interdisciplinary. However, the Bibliography does probably give a

fair representation of the scope, topics and trends in ELT/LSI research. The following is a brief overview of research activity in the various fields.

Education

The education category includes the largest number of ELT/LSI studies. The bulk of studies in education are in higher education (excluding professional education in the specific fields identified below). K-12 education accounts for a relatively small number, as does adult learning alone. However, in many cases adult learning is integrated with higher education. A number of studies in the education category have been done in other cultures--UK, Canada, Australia, Finland, Israel, Thailand, China, Melanesia, Spain, Malta, and American Indian.

Many of the studies in higher education use ELT and the LSI as a framework for educational innovation. These include research on the matching of learning style with instructional method and teaching style and curriculum and program design using ELT (e.g., Claxton & Murrell, 1987). A number of publications assess the learning style of various student, faculty and other groups. Other work includes theoretical contributions to ELT, ELT construct validation, LSI psychometrics and comparison of different learning style assessment tools. In adult learning there are a number of publications on ELT and adult development, moral development, and career development. The work of Sheckley and colleagues on adult learning at the University of Connecticut is noteworthy here (e.g., Allen, Sheckley, & Keeton 1992; Travers, 1998). K-12 education research has been primarily focused on the use of ELT as a framework for curriculum design, particularly in language and science. (e.g., McCarthy, 1996; Hainer, 1992)

Management

ELT/LSI research was first published in management and there has continued to be substantial interest in the topic in the management literature. Studies can be roughly grouped into four categories--management and organizational processes, innovation in management education, theoretical contributions to ELT including critique, and psychometric studies of the LSI. Cross-cultural ELT/LSI research has been done in Poland, New Zealand, Australia, Canada, UK, and Singapore. In the management/organization area, organizational learning is a hot topic. Dixon's (1999) book *The Organizational Learning Cycle* is an excellent example.

Another group of studies has examined the relationship between learning style and management style, decision-making, and problem solving. Other work has measured work related learning environments and investigated the effect of a match between learning style and learning environment on job satisfaction and performance. ELT has been used as a framework for innovation in management education including research on matching learning styles and learning environments, program design and experiential learning in computerized business games (e.g., Boyatzis, Cowen, & Kolb, 1995; Lengnick-Hall & Sanders, 1997).

Other education work has been on training design, management development and career development. Another area of research has been on the development and critique of

ELT. Most psychometric studies of the LSI in the early period were published in management, while recent psychometric studies have been published in psychology journals. Hunsaker reviewed the early studies ot the LSI 1 in management and concluded, "The LSI does not demonstrate sufficient reliability to grant it the predictive reliability that such a measurement instrument requires. The underlying model, however, appears to receive enough support to merit further use and development." (1981, p. 151)

Computer and Information Science

The LSI has been used widely in computer and information science particularly to study end-user software use and end-user training (e.g., Bostrom, Olfman, & Sein, 1990; Davis & Bostrom, 1993). Of particular interest for this book on individual differences in cognitive and learning styles is the debate about whether these differences are sufficiently robust to be taken in account in the design of end-user software and end user computer training. Other studies have examined the relationship between learning style and problem solving and decision making, on line search behavior, and performance in computer training and computer assisted instruction.

Psychology

Studies in psychology have shown a large increase over time, with 77% of the studies in the recent period. Many of these recent studies were on LSI psychometrics. The first version of the LSI was released in 1976 and received wide support for its strong face validity and independence of the two ELT dimensions of the learning process (Marshall & Meritt, 1985; Katz, 1986). Although early critique of the instrument focused on the internal consistency of scales and test-retest reliability, a study by Ferrell (1983) showed that the LSI version 1 was the most psychometrically sound among four learning instruments of that time. In 1985 version 2 of the LSI was released and improved the internal consistency of the scales (Veres, Sims, & Shake, 1987; Sims, Veres, Watson, & Buckner, 1986). Critiques of this version focused their attention on the test-retest reliability of the instrument, but a study by Veres, Sims, and Locklear (1991) showed that randomizing the order of the LSI version 2 items results in dramatic improvement of test-retest reliability. This finding led to experimental research and finally to the latest LSI revision, LSI Version 3 (Kolb 1999a). The LSI version 3 has significantly improved psychometric properties, especially test-retest reliability (see Kolb, 1999b).

Other research includes factor analytic studies of the LSI, construct validation studies of ELT using the LSI, and comparison of the LSI with other learning style and cognitive style measures. Another line of work uses ELT as a model for personal growth and development, including examination of counselor/client learning style match and its impact on counseling outcomes. Notable here is the work of Hunt and his colleagues at the Ontario Institute for Studies in Education (Hunt, 1992,1987).

Medicine

The majority of studies in medicine focus on learning style analysis in many medical education specialties--residency training, anesthesia education, family medicine, surgical

training, and continuing medical education. Of significance here is the program of research by Baker and associates (e.g., Baker, Cooke, Conroy, Bromley, Hollon, & Alpert, 1988; Baker, Reines, & Wallace, 1985). Also Curry (1999) has done a number of studies comparing different measures of learning styles. Other research has examined clinical supervision and patient/physician relationships, learning style and student performance on examinations, and the relationship between learning style and medical specialty career choice.

Nursing

ELT/LSI research has also increased dramatically with 81% of the nursing studies in the recent period. In 1990 Laschinger reviewed the experiential learning research in nursing and concluded, "Kolb's theory of experiential learning has been tested extensively in the nursing population. Researchers have investigated relationships between learning style and learning preferences, decision-making skills, educational preparation, nursing roles, nursing specialty, factors influencing career choices and diagnostic abilities. As would be expected in a human service profession, nursing learning environments have been found to have a predominantly concrete learning press, matching the predominating concrete styles of nurses…Kolb's cycle of learning which requires the use of a variety of learning modalities appears to be a valid and useful model for instructional design in nursing education" (p. 991).

Accounting

There has been considerable interest in ELT/LSI research in accounting education, where there have been two streams of research activity. One is the comparative assessment of learning style preferences of accounting majors and practitioners, including changes in learning style over the stages of career in accounting and the changing learning style demands of the accounting profession primarily due to the introduction of computers. Other research has been focused on using ELT to design instruction in accounting and studying relationships between learning style and performance in accounting courses.
In 1991 Stout and Ruble reviewed ELT/LSI research in accounting education. Reviewing the literature on predicting the learning styles of accounting students they found mixed results and concluded that low predictive and classification validity for the LSI was a result of weak psychometric qualities of the original LSI and response set problems in the LSI 1985. They tentatively recommended the use of the randomized version proposed by Veres, Sims, and Locklear (1991). They write, "researchers who wish to use the LSI for predictive and classification purposes should consider using a scrambled version of the instrument", and note, "…it is important to keep in mind that assessing the validity of the underlying theoretical model (ELT) is separate from assessing the validity of the measuring instrument (LSI). Thus, for example, the theory may be valid even though the instrument has psychometric limitations. In such a case, sensitivity to differences in learning styles in instructional design may be warranted, even though assessment of an individual's learning style is problematic" (p. 50).

Law

We are now seeing the beginning of significant research programs in legal education, for example the program developed by Reese (1998) using learning style interventions to improve student learning at the University of Denver Law School.

Evaluation of ELT and the KLSI

There have been two recent comprehensive reviews of the ELT/LSI literature, one qualitative and one quantitative. In 1991 Hickox extensively reviewed the theoretical origins of ELT and qualitatively analyzed 81 studies in accounting and business education, helping professions, medical professions, post-secondary education and teacher education. She concluded that overall 61.7% of the studies supported ELT, 16.1% showed mixed support, and 22.2% did not support ELT.

In 1994 Iliff conducted a meta-analysis of 101 quantitative studies culled from 275 dissertations and 624 articles that were qualitative, theoretical, and quantitative studies of ELT and the LSI. Using Hickox's evaluation format he found that 49 studies showed strong support for the LSI, 40 showed mixed support and 12 studies showed no support. About half of the 101 studies reported sufficient data on the LSI scales to compute effect sizes via meta-analysis. Most studies reported correlations he classified as low (<.5) and effect sizes fell in the weak (.2) to medium (.5) range for the LSI scales. In conclusion Iliff suggests that the magnitude of these statistics is not sufficient to meet standards of predictive validity.

Most of the debate and critique in the ELT/LSI literature has centered on the psychometric properties of the LSI. Results from this research have been of great value in revising the LSI in 1985 and again in 1999. Other critique, particularly in professional education, has questioned the predictive validity of the LSI. Iliff correctly notes that the LSI was not intended to be a predictive psychological test like IQ, GRE or GMAT. The LSI was originally developed as a self-assessment exercise and later used as a means of construct validation for ELT. Judged by the standards of construct validity ELT has been widely accepted as a useful framework for learning centered educational innovation, including instructional design, curriculum development, and life-long learning. Field and job classification studies viewed as a whole also show a pattern of results consistent with the ELT structure of knowledge theory described in Table 1.

Recent critique has been more focused on the theory than the instrument examining the intellectual origins and underlying assumptions of ELT from what might be called a post-modern perspective where the theory is seen as individualistic, cognitivist, and technological (e.g. Kayes 2002, Vince, 1998; Holman, 1997; Hopkins, 1993).

INTERNAL VALIDITY EVIDENCE

Several predictions can be made from ELT about the relationship among the scales of the Learning Style Inventory. These relationships have been empirically examined in two ways—through a first order correlation matrix of the six LSI scales and through factor analysis of the four primary LSI scales and/or inventory items.

Correlation Studies of the LSI Scales.

ELT proposes that the four primary modes of the learning cycle—CE, RO, AC & AE--are composed of two independent dialectic (bi-polar) dimensions--a "grasping" dimension measured by the combination score AC-CE and a "transformation" dimension measured by the AE-RO combination score. Thus, the prediction is that AC-CE and AE-RO should be uncorrelated. Also, the CE and AC scales should not correlate with AE-RO and the AE and RO scales should not correlate with AC-CE. In addition the dialectic poles of both combination dimensions should be negatively correlated, though not perfectly since the dialectic relationship predicts the possibility of developmental integration of the opposite poles. Finally, the cross dimensional scales—CE/RO, AC/AE, CE/AE & AC/RO--should not be correlated as highly as the within dimension scales.

Table 7 shows these critical scale inter-correlations for the total normative sample and the sub-samples. Correlations of AC and CE with the AC-CE dimension and AE and RO with the AE-RO dimensions are not included because they are artificially inflated (all are above .8) because the combination score includes the scale score. The correlations between AC-CE and AE-RO are significant but low. The correlation of .21 for the total norm group indicates that the two scales share only 4.4% common variance. This correlation is somewhat higher than for the LSI 2 norm group (-.09). RO has very low correlations with AC-CE but correlations of AE with AC-CE are somewhat higher. Correlations of AC with AE-RO are quite low but with CE are somewhat higher. As predicted both AC & CE and AE & RO are highly negatively correlated. The cross dimensional scales, CE/AE and AC/RO have low correlations as predicted, but the CE/RO and AC/AE have higher correlations than predicted.

Table 7. KLSI 3.1/3.2 Scale Inter-correlations

Sample	N	ACCE /AERO	ACCE /RO	ACCE /AE	AERO /CE	AERO /AC	CE /AC	RO /AE	CE /RO	AC /AE	CE /AE	AC /RO
TOTAL NORM GROUP	6977	-.21 p<.001	.10	-.26	.24	-.14	-.44	-.43	-.42	-.45	-.03	-.20
Online users	5023	-.25 p<.001	.13	-.30	.26	-.17	-.45	-.44	-.44	-.48	.00	-.18
Research university freshmen	288	-.02 ns	-.06	-.10	.06	.01	-.41	-.41	-.28	-.34	-.20	-.34
Lib. Arts college students	221	-.14 p<.05	.14	-.10	.15	-.08	-.34	-.48	-.42	-.35	-.18	-.20
Art college UG	813	-.25 p<.01	.18	-.23	.30	-.14	-.35	-.38	-.52	-.44	-.06	-.18
Research university MBA	328	-.20 p<.01	.10	-.25	.17	-.18	-.45	-.45	-.36	-.46	-.07	-.16
Distance e-learn adult UG	304	-.12 p<.05	-.01	-.22	.18	-.03	.37	-.36	-.36	-.41	-.08	-.31

Significance levels for correlations involving ipsative scales CE, RO, AC, & AE are not reported since they are not meaningful because of method induced negative correlations.

Factor Analysis Studies.

We have identified 17 published studies that used factor analysis to study the internal structure of the LSI. Most of these studies have focused on the LSI 2, have studied different kinds of samples and have used a number of different factor extraction and rotation methods and criteria for the interpretation of results. Seven of these studies supported the predicted internal structure of the LSI (Merritt & Marshall 1984, Marshall & Merritt 1985, Marshall & Merritt1986, Katz 1986, Brew 1996, Yaha 1998, and Kayes 2005), four studies found mixed support (Loo 1996 & 1999, Willcoxson & Prosser 1996 and Brew 2002), and six studies found no support (Manfredo 1989, Newstead 1992, Cornwell, Manfredo & Dunlop 1991, Geiger, Boyle & Pinto 1992, Ruble & Stout 1990 and Wierstra & de Jong 2002).

Factor analysis of the total normative sample and sub-groups follows recommendations by Yaha (1998). Principal components analysis with varimax rotation was used to extract 2 factors using the 4 primary LSI scales. Analysis at the item level was not done since it is not the item scores, but the scale scores that are proposed as operational measures of the ELT learning mode constructs. Also, the -.33 correlation among the four items in a set (resulting from the ipsative forced choice format) makes the interpretation of item factor loadings difficult. Loo argues that the analysis by scale scores alleviates this problem. "It should be noted that factoring scale scores (i.e. Yaha 1998) rather than item scores bypasses the issue of ipsative measures when testing for the two bi-polar dimensions (1999: 216).

ELT would predict that this factor analysis procedure would produce two bipolar factors, one with AC & CE as poles and the other with AE and RO as poles. This is the result for the research university freshmen sample, the liberal arts college sample, and the research university MBA students. However, the total normative sample, the online users, and the distance e-learning students show a more mixed result with the AC scale as one pole and a combination of CE and AE as the other in factor one. In factor two RO is the dominant pole and CE and AE are the other pole. The art sample shows two different bipolar factors with RO and CE as poles in factor one and AC and AE as poles in factor two. The percent of variance explained by the two factors was about the same in all seven analyses with the total being between 70 & 75%, factor one 36-41% and factor two 29-35%.

Table 8. Norm Group Factor Analysis of KLSI 3.1/3.2 Scales

Sample	Factor	CE	RO	AC	AE
TOTAL	1	.525	.053	-.988	.520
NORM	2	.438	-.998	.148	.475
Online	1	.471	.056	-.991	.582
users	2	.511	-.996	.120	.433
Research	1	.686	.152	-.945	.216
university	2	.116	-.906	.077	.760
freshmen					
Lib. Arts	1	.167	-.918	.041	.781
college	2	-.775	.044	.856	-.079
students					
Art college	1	.780	-.937	.048	.209
undergrad	2	.180	.021	-.918	.752
Research	1	.665	.064	-.965	.339
university	2	-.215	.952	-.030	-.694
MBA					
Distance	1	.512	-.019	-.931	.613
e-learning	2	.397	-.992	.342	.333
adult UG					

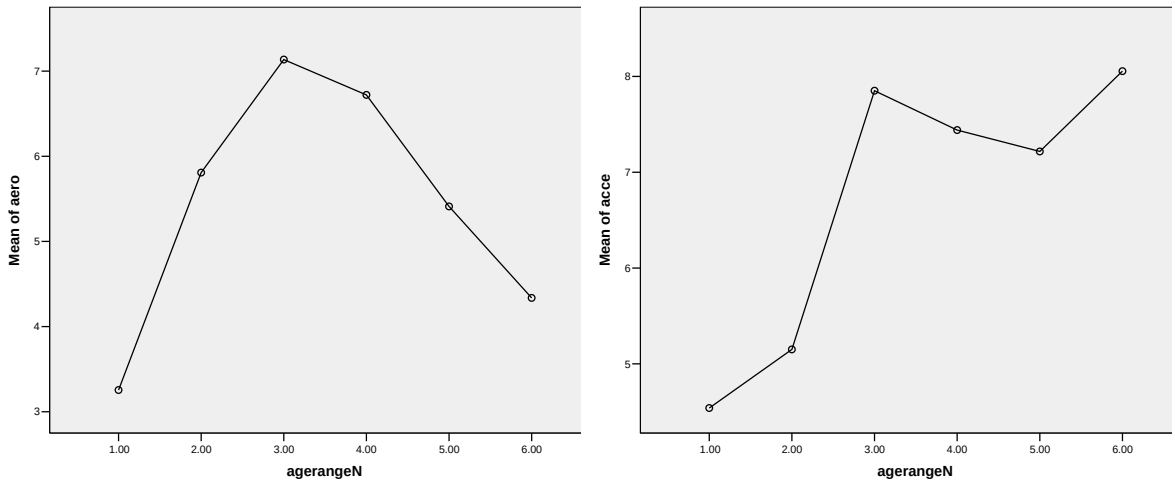
Overall the results of correlation and factor analysis studies show similar results. As Loo notes, "…with only four scale scores, factoring may be unnecessary because the factor pattern structure can be accurately estimated from an inspection of the correlation pattern among the four scales" (1999: 216). These data are consistent with previous versions of the LSI (Kolb 1976b, 1985b) and give qualified support for the ELT basis for the inventories. The support must be qualified because the higher than predicted negative correlations between AC & AE and CE & RO in the KLSI 3.1 normative groups is not predicted and results in the slightly increased negative correlation between AC-CE and AE-RO and the mixed factor analysis results for all but the research university freshmen, the liberal arts college students and the distance e-learning sample.

EXTERNAL VALIDITY EVIDENCE

Age

Previous research with the LSI 1 showed a linear increase in preference for learning by abstraction with age as measured by the AC-CE scale and a curvilinear relationship with learning by action as measured by AE-RO with middle age being the most active period of life (Kolb 1976b). Results from the KLSI 3.1 normative sample show similar significant relationships between the combination scores and six age ranges--<19, 19-24, 25-34, 35-44, 45-54 and >55 with much larger age cohort sample sizes than the LSI 1 norm group. See Figure 3 and Appendix 2 for complete descriptive statistics and ANOVA results.

Figure 3. KLSI 3.1 Scores on AC-CE and AE-RO by Age Range



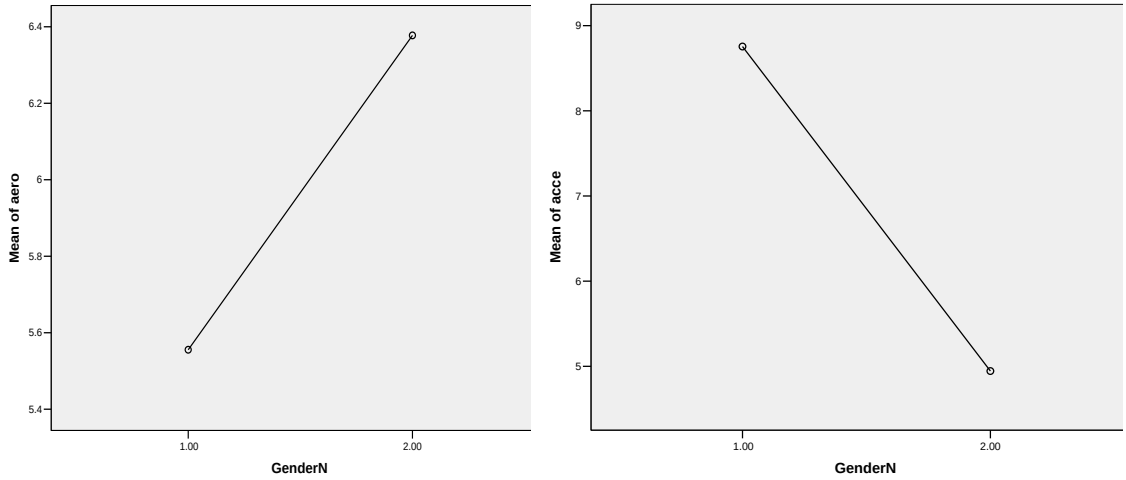
Gender

Previous research with the LSI 1 and LSI 2 normative groups showed that males were more abstract that females on the AC-CE scale and that there were no significant gender differences on the AE-RO dimension (Kolb 1976b, 1985b). Results from the KLSI 3.1 normative sample show similar significant gender differences on AC-CE and smaller but significant differences on AE-RO. See Figure 4 and Appendix 3 for complete descriptive statistics and ANOVA results. These results need to be interpreted carefully since educational specialization and career choices often interact with gender differences making it difficult to sort out how much variance in LSI scores can be attributed to gender alone and how much is a function of ones educational background and career (Willcoxson and Prosser 1996). Also, statements like "Women are concrete and men are abstract" are unwarranted stereotypical generalizations since mean differences are statistically significant but there is considerable overlap between male and female distributions on AC-CE and AE-RO.

These consistent differences by gender on the LSI AC-CE scale provide a theoretical link between ELT and the classic work by Belenky et al., *Womens Ways of Knowing* (1986). They used gender as a marker to identify two different epistemological

orientations, connected knowing and separate knowing which their research suggested characterized women and men respectively. Connected knowing is empathetic and interpersonal and theoretically related to CE and separate knowing emphasizes distance from others and relies on challenge and doubt, related to AC. Knight et al. (1997) tested this hypothesized relationship by developing a Knowing Styles Inventory and correlating separate and connected learning with the AC and CE scales of the LSI. They found no relationship between AC and their measure of separate knowing for men or women and no relationship between CE and connected knowing for women. However, they did find a significant correlation between CE and connected knowing for men.

Figure 4. KLSI 3.1/3.2 Scores on AC-CE and AE-RO by Gender



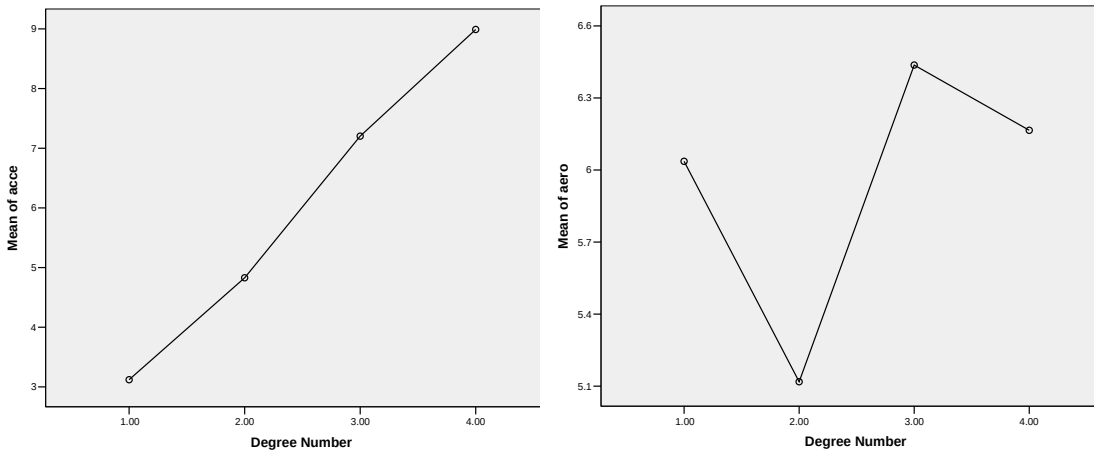
Educational Level

ELT defines two forms of knowledge. *Social knowledge* is based on abstract knowledge that is culturally codified in language, symbols and artifacts. An individual's personal knowledge is based on direct uncodified concrete experience plus the level of acquired social knowledge that he or she has acquired. Hence, the theory predicts that abstractness in learning style is related to an individual's level of participation in formal education. Research relating educational level to learning style in the LSI 1 normative sample (Kolb 1976b) showed the predicted linear relationship between amount of education and abstractness. Data from the KLSI 3.1 normative sample show the same linear relationship between abstractness and highest degree obtained—from Elementary to High School to University to Graduate degree.

Differences among degree groups on the AE-RO dimension are smaller with the largest difference being an increase in active orientation from high school graduates to college graduates. This is similar to results with the LSI 1 normative sample and is supported by longitudinal research that shows increasing movement in learning style from a reflective to an active orientation through the college years (Kolb & Kolb 2005a,

Mentkowski and Strait 1983, Mentkowski and Associates 2000). See Figure 5 and Appendix 4 for complete descriptive statistics and ANOVA results.

Figure 5. KLSI 3.1/3.2 Scores on AC-CE and AE-RO by Level of Education



Educational Specialization

A corollary of the ELT definition of learning as the creation of knowledge through the transformation of experience is that different learning styles are related to different forms of knowledge. Academic disciplines differ in their knowledge structure, technologies and products, criteria for academic excellence and productivity, teaching methods, research methods, and methods for recording and portraying knowledge. Disciplines even show socio-cultural variation- differences in faculty and student demographics, personality and aptitudes, as well as differences in values and group norms. For students, education in an academic field is a continuing process of selection and socialization to the pivotal norms of the field governing criteria for truth and how it is to be achieved, communicated, and used. The resulting educational system emphasizes specialized learning and development through the accentuation of the student's skills and interests. The student's developmental process is a product of the interaction between his or her choices and socialization experiences in academic disciplines. That is, the student's dispositions lead to the choice of educational experiences that match those dispositions. And the resulting experiences further reinforce the same choice dispositions for later experiences. Over time the socialization and specialization pressures combine to produce increasingly impermeable and homogeneous disciplinary culture and correspondingly specialized student orientations to learning.

ELT (Kolb 1981b, 1984) provides a typology of specialized fields of study, learning styles, and forms of knowledge and based on Pepper's (1942) "world hypotheses" framework. Social professions such as education and social work are typified by the accommodating learning style, a way of knowing that is based on contextualism. The science based professions such as medicine and engineering are characterized by the converging learning style which is based on formism. The humanities and social sciences are typified by the diverging learning style and are based on the world hypothesis of organicism.

Mathematics and the natural sciences are characterized by the assimilating learning style and the world hypothesis of mechanism.

Overall, previous research with the LSI shows that student learning style distributions differ significantly by academic fields as predicted by ELT. For example Willcoxson and Prosser in their review of research on learning style and educational specialization using the LSI 1 conclude that there is "some measure of agreement amongst researchers regarding the learning style preferences typically found in specified disciplines and more agreement if disciplines are subsumed under descriptions such as social sciences or humanities. It also appears as specified by experiential learning theory that learning styles may be influenced by environmental demands and thus results obtained for professionals and students in a specified discipline may be dissimilar…in all studies the reporting of a numerical majority as the predominant learning style obscures the range of styles found." (1996: 249)

Their last point is important since ELT does not predict that a match between an individual's learning style and the general knowledge structure of their chosen field is necessary for effectiveness; since learning is essential in all fields and therefore, all learning perspectives are valuable. For example, a person in marketing with an assimilating style of learning doesn't match the typical accommodating style of marketing but, because of his or her assimilating style may be more effective in communicating with research and development scientists (Kolb 1976).

There is considerable variation in inquiry norms and knowledge structures within some fields. Professions such as management (Loo 2002a, 2002b, Brown & Burke 1987) and medicine (Sadler et al. 1978, Plovnick 1975) are multi-disciplinary including specialties that emphasize different learning styles. Social sciences can vary greatly in their basic inquiry paradigms. In addition fields can show variation within a given academic department, from undergraduate to graduate levels and so on. For example, Nulty and Trigwell (1996) caution that the learning style grouping should not be taken as absolute representation of a particular student population, because different teaching strategies and discourse mode may be adopted which are non-traditional to that discipline. Their study also suggests that learning styles are related to the stage the students are in their studies. While students in the first third of their studies adopted learning styles that were similar to each other irrespective of the disciplines, learning styles of students in the final third of their studies tended to be related to the learning requirement of their academic major.

The distinct value systems and educational goals of each educational institution also exert significant influence on differences in students' learning styles. To investigate the relationship between the way a major is structured and student outcomes, Ishiyama and Hartlaub (2003) conducted a comparative study of student learning styles in two different political science curricular models at two Universities. The results indicate that while there was no statistically significant relationship between student learning styles in underclass students, there was a significant difference in mean AC-CE scores among upper class students between the two universities. Students taking the highly structured, concept-centered political science curriculum at Truman State University demonstrated higher abstract reasoning skills than did students enrolled in the flexible, more content-oriented major at

Frostburg State University. The authors suggest that Truman State program better facilitates the academic requirements recommended by Association of American College and University (AACU) to promote abstract reasoning skills and critical thinking skills necessary for the rigors of professional and graduate education than the flexible curriculum structure at Frostburg State. Other researchers and educators also contend that understanding of the distribution of learning styles in one's field of discipline and sub-specialty is crucial for the improvement of the quality of instructional strategies that respond to the individual need of the learner as well as the optimal level of competency and performance requirement of each profession (Baker, Simon, and Bazeli 1986, Bostrom, Olfman, & Sein 1990, Drew and Ottewill 1998; Fox and Ronkowski,1997; Kreber, 2001; Laschinger, 1986; McMurray,1998; Rosenthal, 1999; Sandmire, Vroman, & Sanders 2000; Sims, 1983).

Results from the KLSI online user normative sub-sample show similar results to earlier research on the relationship between learning style and educational specialization. Figure 6 plots the mean scores on AC-CE and AE-RO for respondents who reported different educational specializations and for the three specialized normative subgroups (in bold). Appendix 4 shows the distribution of learning style types for each educational specialty.

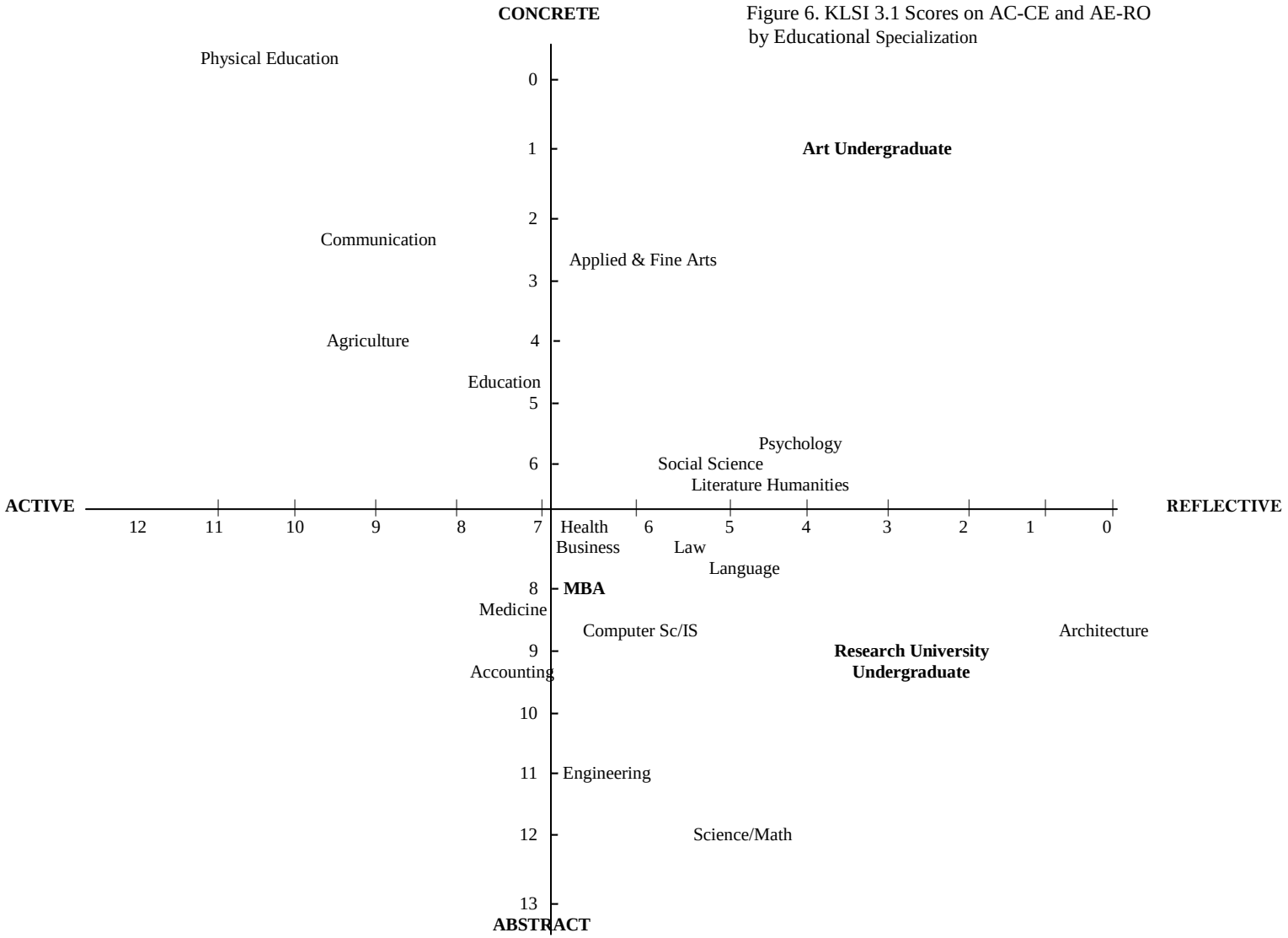


Figure 6. KLSI 3.1 Scores on AC-CE and AE-RO by Educational Specialization

Other Experiential Learning Assessment Instruments.

The Learning Skills Profile

The Learning Skills Profile (LSP, Boyatzis and Kolb 1991a, 1991b, 1995) was developed to assess systematically the adaptive competencies associated with learning style (Kolb 1984). The LSP uses a modified Q-sort method to assess level of skill development in four skill areas that are related to the four learning modes--Interpersonal Skills (CE), Perceptual/Information Skills (RO), Analytical Skills (AC) and Behavioral Skills (AE). Several studies have used the LSP in program evaluation (Ballou, Bowers, Boyatzis, & Kolb, 1999; Boyatzis, Cowen, & Kolb, 1995) and learning needs assessment (Rainey, Hekelman, Glazka, & Kolb, 1993; Smith 1990). Yamazaki et al. (2003) studied the relationship between LSP and LSI 3.1 scores in a sample of 288 research university freshmen. AC-CE was negatively related to the interpersonal skills of leadership, relationship and help and positively related to the analytic skills of theory building, quantitative analysis and technology as predicted. The AE-RO dimension did not relate to the perceptual/information skills of sense making, information gathering and information analysis but did relate to the behavioral skills of goal setting and initiative as predicted (See Table 10). In another study of 198 MBA students, Mainemelis et al. (2002) found similar relationships between LSI 2 scores and the LSI clusters of Interpersonal, Information, Analytic and Behavioral learning skills (See Table 11).

Table 10. Relationship between Learning Skills Profile scores and KLSI 3.1 AC-CE and AE-RO Scales (Yamazaki et al. 2003)

	Interpersonal learning skills (CE)						Perceptual learning skills (RO)						Analytical learning skills (AC)						Behavioral learning skills (AE)					
Variables	**Leadership**		**Relationship**		**Help & understanding**		**Sense making**		**Information gathering**		**Information analysis**		**Theory building**		**Quantitative analysis**		**Technology & computer**		**Goal setting**		**Action**		**Initiative**	
	β	**R^2**	**β**	**R^2**	**β**	**R^2**	**β**	**R^2**	**β**	**R^2**	**β**	**R^2**	**β**	**R^2**	**β**	**R^2**	**β**	**R^2**	**β**	**R^2**	**β**	**R^2**	**β**	**R^2**
AC-CE	-.14*	.06	-.22***	.06	-.24***	.06	.06	.01	-.01	.00	.20***	.04	.30***	.10	.33***	.11	.21***	.04	.16**	.04	.03	.01	-.15**	.07
AE -RO	.19***		.08		.07		.10		.04		.07		.10		-.01		.02		.13*		.09		.22***	
F	8.27***		8.26***		9.54***		1.92		.26		6.58**		15.12***		17.18***		6.36**		6.39**		.89		11.08***	
df	2, 285		2, 285		2, 285		2, 285		2, 285		2, 285		2, 285		2, 285		2, 285		2, 285		2, 285		2, 285	

N = 288
* p < .05
** p < .01
*** p < .001

Table 11. Correlations between LSI 2 and The Learning Skills Profile (Mainemelis et al. 2002)

N	Interpersonal /CE	Information /RO	Analytic /AC	Behavior /AE	Anal.-Interp. /AC-CE	Behav.-Info. /AE-RO
198	.31	-.14	.54	.12	.57	.23

r's> .14 p< .05, r's>.24 p<.001 two-tailed

The Adaptive Style Inventory

The Adaptive Style Inventory (ASI) was developed to assess situational variability in learning style in response to different kinds of learning task demands (Kolb 1984). It uses a paired comparison method to rank learning preferences for the four learning modes in eight personalized learning contexts. It measures adaptive flexibility in learning, the degree to which one systematically changes learning style to respond to different learning situations in their life. Earlier studies found that adaptive flexibility is positively related to higher levels of ego development on Loevinger's instrument (Kolb & Wolfe, 1981). Individuals with high adaptive flexibility are more self-directed, have richer life structures, and experience less conflict in their lives (Kolb, 1984).

Mainemelis, Boyatzis and Kolb (2002) employed the LSI 2, the Adaptive Style Inventory (Boyatzis and Kolb 1993), and the Learning Skills Profile (LSP, Boyatzis and Kolb 1991, 1995, 1997) to test a fundamental ELT hypothesis: The more balanced people are in their learning orientation on the LSI, the greater will be their adaptive flexibility on the ASI. To assess a balanced LSI profile two different indicators of a balanced learning profile using absolute LSI scores on the Abstract/Concrete and Active/Reflective dimensions were developed. The results supported the hypotheses showing that people with balanced learning profiles in both dimensions of the LSI are more adaptively flexible learners as measured by the ASI. The relationship was stronger for the profile balanced on the Abstract/Concrete dimension than the active/reflective dimension. Other results showed that individuals with specialized LSI learning styles have a greater level of skill development in the commensurate skill quadrant of the LSP. The study also produced some unexpected results. For example, while it was predicted that specialized learning styles would show less adaptive flexibility on the ASI, the results showed that this is true for the abstract learning styles but not for the concrete styles.

The ASI also produces total scores for the sum of the eight different learning contexts on the four basic learning modes. Table shows the correlations between these total ASI scores and the scales of the LSI 2 indicating high concurrent validity between the two instruments.

Table 9. Correlations between LSI 2 and Adaptive Style Inventory Scale Scores

Source	N	CE	RO	AC	AE	AC-CE	AE-RO
Mainemelis *et.al.* (2002)	198	.43	.37	.49	.42	.53	.44

r's>.28 p< .001 two-tailed

The Honey-Mumford Learning Styles Questionnaire

Honey and Mumford (1982, 1992) developed the Learning Styles Questionnaire (LSQ) based on ELT with the aim to create an instrument that was phrased in the language of UK managers and of pragmatic value to them, not "something that was academically respectable" (1986: 5). While they base their learning styles on the learning cycle they define the four learning modes somewhat differently. Three of the learning modes on the face of it appear similar to ELT; Reflector and RO, Theorist and AC and Pragmatist and AE; but the fourth mode Activist and CE is not, confusing concrete experience and active experimentation. This appearance is supported by a cluster analysis and factor analysis of the LSQ by Swailes and Senior (1999) who found a three stage learning cycle of action, reflection and planning instead of the ELT four stage cycle. Honey and Mumford's (1982) correlation of the LSI 1 and the LSQ is also consistent although the sample is quite small. In a larger study of undergraduate students by Sims Veres and Shake (1989) there was very little relationship between any of the LSI 2 and LSQ scales. Another study by Goldstein et al. (1992) of 44 students and faculty found similar small correlations between the LSQ and LSI 1 and LSI 2 scales (See Table 12). They argued with some justification that the proper correspondence between the LSQ and LSI is between the LSQ scales and the LSI learning style types (eg. Activist = Accommodating) but found little evidence to support it. Only 41% were correctly classified with the LSI 1 and 29% with LSI 2. In addition a factor analysis of the LSQ by De Ciantis and Kirton (1996) failed to support the two bipolar dimensions, AC-CE and AE-RO predicted by ELT; as did a study by Duff and Duffy (2002). Finally, Mumford in Swailes and Senior (2001:215) stated, "the LSQ is not based upon Kolb's bi-polar structure as the academic community seems to think".

Given these results, caution should be used in equating scores from the LSI and LSQ and in interpreting LSQ research as either confirming or disconfirming ELT.

Table 12. Correlations of the Honey-Mumford Learning Styles Questionnaire with the LSI 1 and LSI 2

Source	N	LSI version	Activist-CE	Reflector-RO	Theorist-AC	Pragmatist-AE
Honey & Mumford 1982	29	LSI 1	.23	.73	.54	.68
Sims,et.*al.* 1989	279	LSI 2	.22***	.28***	.11*	.01
Goldstein et al. 1992	44	LSI 1 LSI 2	.23 .43**	.09 .14	.36* .23	.38* .38*

*** p < .001, ** p<.01,* p < .05 No sig. levels reported by Honey & Mumford

Aptitude Test Performance

Studies of the relationship between learning style and aptitude test performance have consistently found that individuals with abstract, and sometimes active, learning styles perform best on tests of this type. Boyatzis and Mainemelis (2000) found significant correlations (p<.001) between the total GMAT scores of MBA students and their LSI 2 scores on AC-CE (.16 for 576 full time students and .19 for part time students) and on AC (.23 FT and . 21 PT). Data from the research university freshmen normative sample shows significant correlations (p<.001) between their total SAT scores and the KLSI 3.1 AC-CE (.32) and AC (.37) scales. Kolb (1976b) reported significant correlations between the LSI 1 and the LSAT for a sample of 43 law students for RO (-.29 p< .05) and for AC (.30 p<.05)

Two studies have examined the relationship between the Wonderlic test of general mental ability and the LSI. Kolb (1976b) reported data from 311 industrial managers indicating significant positive relationships between the LSI 1 AC-CE (.18 p<.01) and AE-RO (.24 p<.001) scales and Wonderlic scores. Cornwall and Manfredo (1994) studied the relationship between learning style and the Wonderlic in a group of 74 students and young working professionals. They scored the LSI 2 using a nominal scoring method and found that those whose primary learning mode was AC score significantly higher than those with the other primary learning modes.

While some have concluded that these relationships between AC and aptitude test performance indicate that abstract persons have greater mental ability (eg. Cornwall and Manfredo 1994) it is also possible that the one best answer format of tests of this type is biased toward the converging learning style (See below).

Assessment of Academic Performance.

A number of studies have examined the relationship between learning style, assessment method and academic performance. While some studies show relationships between grades and the converging learning style (Rutz 2003, Mainemelis et al. 2000), other

studies indicate that these learning style differences in student performance may be a function of the assessment technique used.

Lynch, Woelfl, Steele, & Hanssen explored the relationship between learning style and three different academic performance measures in a third-year surgery clerkship in a medical school. Two cohorts of third-year medical students took the United States Medical Licensing Examination step1 (USMLE 1), the National Board of Medical Examiners (NBME), and NBME computer-based case simulations (CBX). The USMLE 1 and NBME subject examination rely on a single best answer, multiple-choice question format to assess performance, whereas CBX is a complex computer simulation intended to measure clinical management skills: The CBX consists of eight patient management simulations, each involving a patient with an unknown surgical problem. The simulation allows the student to obtain results of the history and physical examination, to order laboratory studies, to request radiology procedures, and to perform invasive/interventional procedures of surgeries. Beyond the presenting complaint, management is unprompted, and the student must balance the clinical evaluation with the acuity and progression of the clinical problem. Time advances during the simulation in proportion to the time necessary to perform each examination, laboratory study, or intervention. (1998: 63). Of the 227 participants in the study, 102(45%) were converging learners, 59(26%) assimilating, 48(21%) accommodating, and 18(8%) were diverging learners. The result indicated that converging and assimilating learners scored significantly higher on the two multiple choice performance measures, while no learning style difference was found on the CBX computer simulation. The authors concluded that the results support the Kolb (1984) and Newland (1992) assertions that converging and assimilating learners may have a performance advantage on objective, single-best answer multiple choice examination. They also concluded that the absence of relationships between learning style and CBX simulation suggests that multiple choice examination and clinical case simulations measure different capabilities and achievements. Clinical management may require not only an abstract orientation supporting the acquisition, organization, and synthesis of preclinical basic science data, but also a concrete orientation involving pattern recognition and instinct. The data demonstrate the importance of evaluating learning outcomes by applying more than one type of examination format. Multiple-choice examinations favor abstract learners, however, clinical performance requires additional cognitive skills and abilities, and behaviors that are not adequately reflected in objective measures of performance.

Oughton & Reed (2000) measured the relationship between graduate students' learning styles and performance outcome in a hypermedia environment in which students are required to structurally map out their acquired knowledge and grasp the interrelationships among various ideas and concepts. The dependent measures included the number of concepts, number of nodes, number of links, number of bidirectional links, number of multiple concept nodes, number of nodes with multiple links, levels of depth, preserved concepts, omitted concepts, and added concepts on each student's map. The results show that assimilating and diverging learners were the most productive on their concept maps. The authors concluded that this result can be attributed to the common traits shared by the two learning styles: the ability to see many perspectives and the ability to generate many ideas.

Holley & Jenkins (1993) examined the impact of learning style on four different accounting exam question formats: multiple-choice theory (MCT), multiple-choice quantitative (MCQ), open-ended theory (OET), and open-ended quantitative (OEQ). Their results indicated that there was a significant performance difference by learning style for all but the multiple – choice quantitative format. On the active-reflective learning style continuum, there was a significant difference in students' performance on the multiple choice theory format ($p < .01$) and the open-ended quantitative format ($p < .05$) with active students performing better. On the abstract-concrete learning style continuum, abstract students performed better on the open-ended theory format ($p < .062$). The authors concluded that students with different learning styles perform differently depending on the examination format, and that performance cannot be generalized for similar subjects if the testing format varies.

This research suggests that educators need to exercise caution in evaluating performance based on a single outcome measure. Diverse assessment strategies are required to adequately measure student overall competence and performance.

Experiential Learning in Teams

Current research, involving different methodologies and different educational and workplace populations, has shown that ELT is useful for understanding team learning and performance (Adams, Kayes & Kolb 2005a). A number of studies support the proposition that a team is more effective if it learns from experience and emphasizes all four learning modes. Summarized below are studies of team member learning style, team roles, and team norms.

Team member learning style.

In the first experimental study of the effect of learning styles on team performance, Wolfe (1977) examined how homogeneous three-person teams of accommodators, divergers, assimilators, or convergers performed on a complex computer business simulation compared with heterogeneous teams. The four groups of homogeneous teams had similar performance results. However, the teams that had members with diverse learning styles performed significantly better, earning nearly twice the amount of money of the homogeneous learning style teams. Similarly, Kayes (2001) found that teams made up of members whose learning styles were balanced among the four learning modes performed at a higher level on a critical thinking task than teams whose members had specialized learning styles.

Sandmire and Boyce (2004) investigated the performance of two-person collaborative problem-solving teams in an allied health education anatomy, physiology, and pathology course. They compared a group of high abstract/high concrete student pairs with a group of abstract pairs and a group of concrete pairs. The abstract/concrete pairs performed significantly better on a simulated clinical case than the abstract pairs and slightly better than the concrete pairs, indicating the value of integrating the abstract and concrete dialectics of the learning cycle. However, a similar study by Sandmire, Vroman, and Sanders (2000) investigating pairs formed on the action/reflection dialectic showed no significant performance differences.

Halstead and Martin (2002) found that engineering student teams that were formed randomly to include all learning styles performed better that self-selected teams. Furthermore, in her studies of engineering students, Sharp stated, "Classroom experience shows that students can improve teamwork skills with Kolb theory by recognizing and capitalizing on their strengths, respecting all styles, sending messages in various ways, and analyzing style differences to resolve conflict and communicate effectively with team members" (2001, F2C-2). In his study of a 6-week teambuilding program, Hall (1996) reported difficulty with self-selected teams that tended to group on the basis of friendship. He advocated random team assignment, concluding, "If we had taken this approach there would have been more disagreement to work through, personality clashes to cope with and conflict to resolve. The stress would have been greater, but the *learning* probably more profound" (1996, p. 30).

Using another approach, Jackson studied the learning styles of ongoing workgroup team members who participated in a paired team competition. The exercise was designed to require teamwork skills. Results showed that teams with a balanced learning styles performed better. In 17 of the 18 team pairs, the winning team average score was higher than that of the losing team. Jackson concluded, "Designing teams that reflect the dynamic nature of team activities has great appeal in that it gives all team members a more equal opportunity to contribute and a more equal opportunity to be valued. . . . The process model advocates that different team members lead in different team activities or learning situations (2002, p. 11).

Team roles.

Park and Bang (2002) studied the performance of 52 Korean industrial work teams using the Belbin team role model, which is conceptually linked to ELT (Jackson, 2002). They found that the best-performing teams were those whose members adopted at a high level all nine of Belbin's roles covering all stages of the learning cycle. They also found that teams with roles that matched the particular stage of a team's work/learning process performed best.

McMurray (1998) organized his English as a foreign language classroom using ELT principles. He divided his Japanese students into four-person teams with maximally diverse learning styles. Students were assigned to one of four roles that matched their strongest learning mode: leader (concrete experience), artist (reflective observation), writer (abstract conceptualization), and speaker (active experimentation). The leader's role was to direct classmates in completing assignments; the artist's, to create ideas for presentations; and the writer's, to compose messages for speakers to read. Class lessons were organized to include all four stages of the learning cycle. Classroom observations supported the idea that students benefited from the team role assignment and from accounting for learning style in the course design.

Gardner and Korth used ELT, learning styles, and the learning cycle to develop a course for human resource development graduate students that focused on learning to work

in teams. They found strong relationships between learning styles and preference for learning methods—assimilators preferred lectures, reading, writing, and individual work, while accommodators and often divergers and convergers preferred partner and group work. They advocated providing different student roles during team learning activities to develop appreciation for, and skill in, all learning styles. "Part of the class could actively participate in a role play (accommodating), while a second group observes and provides feedback to the participants (diverging), a third group develops a model/theory from what they have seen and shares it with the class (assimilating) and the fourth group develops a plan for applying what they have seen to a new situation and shares it with the class (converging)" (1999, p. 32).

Team norms.

Carlsson, Keane, and Martin used the ELT learning cycle framework to analyze the bi-weekly reports of research and development project teams in a large consumer products corporation. Successful project teams had work process norms that supported a recursive cycling through the experiential learning cycle. Projects that deviated from this work process by skipping stages or being stuck in a stage "indicated problems deserving of management attention" (1976, p. 38).

Gardner and Korth used ELT to design a course in group dynamics, group development, and group effectiveness. They taught student learning teams to use the experiential learning cycle to improve the transfer of learning. They concluded, "The use of learning groups in conjunction with the experiential learning model enhances the learning process, reinforces the link between theory and practice, and facilitates the transfer of learning to the workplace" (1997, p. 51).

Pauleen, Marshall, & Ergort used ELT to construct and implement web-based team learning assignments in a graduate-level course in knowledge management. Students worked on projects in virtual teams. Follow-up student evaluations indicated that 75% "agreed or strongly agreed that experiential learning was a valuable way of experiencing and learning about a variety of communication channels in a team environment" (2004, p. 95); 99% found experiential learning to be more valuable than simply reading about something.

Two studies have explicitly examined team conversational learning spaces with norms that support the experiential learning cycle. Wyss-Flamm (2002) selected from a management assessment and development course three multicultural student teams who rated themselves as high in psychological safety, defined as the ability of the team to bring up and talk about difficult or potentially psychologically uncomfortable issues. Three of the teams rated themselves as low in psychological safety. Through intensive individual and team interviews, she analyzed the teams' semester-long experience. In teams with high psychological safety, the conversations followed a recursive experiential learning cycle: differences were experienced among team members, examined through reflective juxtaposition that articulated learning, and culminated in either an integration of the differences or an affirmation of the contrast. Teams with low psychological safety tended to have early disturbing incidents that limited conversation and made the conversational flow more turbulent and conflict filled. Lingham (2004) developed a questionnaire to assess the

norms of conversational space in a sample of 49 educational and work teams. He found that the more the teams supported the experiential learning cycle through norms that focused their conversation on interpersonal diverging (concrete experience and reflective observation) and task-oriented converging (abstract conceptualization and active experimentation), the better they performed, the more satisfied they were with their membership on the team, and the more they felt psychologically safe to take risks on the team.

Based on the above research a workbook of structured experiential learning exercises designed to promote team learning has been developed--*The Kolb Team Learning Experience* (Kayes, Kayes, Kolb & Kolb 2004). The workbook program uses the experiential learning cycle and members' learning style information to help teams learn about their purpose, work process, team membership, roles, context and action plans. Initial research on the impact on this educational intervention suggests that the program is effective in promoting team learning in educational and organizational settings (Adams, Kayes & Kolb 2005b).

Educational Applications

The ELT holistic approach proposes that learning interventions that foster all four learning modes result in more effective learning outcomes. The holistic approach engages all learners by appealing to their preferred style at some point in the learning process, thus providing a way for all learners to enter the cycle. Additionally, a holistic approach enhances the learner's flexibility in enacting different styles over time, as well as increasing learning comprehension and retention. In this respect, the primary purpose of the LSI and ELT is to increase individuals' understanding of the process of learning from experience and their unique individual approach to learning. By providing a language for talking about learning styles and the learning process the inventory can foster conversation among learners and educators about how to create the most effective learning environment for those involved. There have been many studies that have used ELT and the LSI in this way to improve the learning process in education.

Since its first statement in 1971 (D. Kolb, 1971; D. Kolb, Rubin, & McIntyre, 1971), there have been many studies using ELT to advance the theory and practice of experiential learning. Because ELT is a holistic theory of learning that identifies learning differences among academic specialties, it is not surprising to see that ELT research is highly interdisciplinary, addressing learning and educational issues in many fields. Research on ELT has increased dramatically in recent years, tripling in number since 2000. The 2013 Experiential Learning Theory Bibliographies (Kolb & Kolb, 2013 www.learningfromexperience.com) include 3564 entries.

The Kolb Learning Style Inventory- Version 4.0: A Comprehensive Guide to the Theory, Psychometrics, Research on Validity and Educational Applications (Kolb & Kolb 2013) summarizes selected studies of experiential learning method and the KLSI applied in thirty different professions and academic disciplines. The studies reported cover a broad range of applications using ELT and the KLSI. Some studies have used the KLSI and the

experiential learning cycle to understand and manage differences between students and faculty learning styles. Some educators have used an experimental design to compare the effectiveness of an experiential learning method with a more traditional course format, whereas others have developed and implemented instructional methods using the experiential learning model as a framework. While instructional strategies and methods were designed to fit the academic requirements of a specific field, many of the experiential activities reported in the studies can be broadly applied to different fields with adequate modifications.

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APPENDIX 1
KLSI 3.1 Raw Score to Percentile Conversion

Concrete Experience

Raw Score		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	12	12	.2	.2	.2
	13	56	.8	.8	1.0
	14	72	1.0	1.0	2.0
	15	103	1.5	1.5	3.5
	16	178	2.5	2.6	6.0
	17	223	3.2	3.2	9.2
	18	315	4.5	4.5	13.7
	19	342	4.8	4.9	18.6
	20	360	5.1	5.2	23.8
	21	423	6.0	6.1	29.9
	22	450	6.4	6.4	36.3
	23	468	6.6	6.7	43.0
	24	410	5.8	5.9	48.9
	25	444	6.3	6.4	55.3
	26	399	5.6	5.7	61.0
	27	368	5.2	5.3	66.3
	28	334	4.7	4.8	71.0
	29	309	4.4	4.4	75.5
	30	246	3.5	3.5	79.0
	31	234	3.3	3.4	82.4
	32	209	3.0	3.0	85.4
	33	202	2.9	2.9	88.2
	34	160	2.3	2.3	90.5
	35	131	1.9	1.9	92.4
	36	123	1.7	1.8	94.2
	37	88	1.2	1.3	95.4
	38	63	.9	.9	96.3
	39	57	.8	.8	97.2
	40	54	.8	.8	97.9
	41	40	.6	.6	98.5
	42	30	.4	.4	98.9
	43	33	.5	.5	99.4
	44	15	.2	.2	99.6
	45	12	.2	.2	99.8
	46	6	.1	.1	99.9
	47	4	.1	.1	99.9
	48	4	.1	.1	100.0
	Total	6977	98.7	100.0	
Missing	System	89	1.3		
Total		7066	100.0		

Reflective Observation

Raw Score		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	12	8	.1	.1	.1
	13	47	.7	.7	.8
	14	53	.8	.8	1.5
	15	75	1.1	1.1	2.6
	16	111	1.6	1.6	4.2
	17	130	1.8	1.9	6.1
	18	159	2.3	2.3	8.4
	19	205	2.9	2.9	11.3
	20	216	3.1	3.1	14.4
	21	288	4.1	4.1	18.5
	22	310	4.4	4.4	23.0
	23	337	4.8	4.8	27.8
	24	348	4.9	5.0	32.8
	25	365	5.2	5.2	38.0
	26	362	5.1	5.2	43.2
	27	354	5.0	5.1	48.3
	28	332	4.7	4.8	53.0
	29	350	5.0	5.0	58.0
	30	346	4.9	5.0	63.0
	31	305	4.3	4.4	67.4
	32	287	4.1	4.1	71.5
	33	305	4.3	4.4	75.9
	34	283	4.0	4.1	79.9
	35	235	3.3	3.4	83.3
	36	230	3.3	3.3	86.6
	37	188	2.7	2.7	89.3
	38	170	2.4	2.4	91.7
	39	145	2.1	2.1	93.8
	40	123	1.7	1.8	95.6
	41	93	1.3	1.3	96.9
	42	69	1.0	1.0	97.9
	43	43	.6	.6	98.5
	44	38	.5	.5	99.0
	45	29	.4	.4	99.5
	46	28	.4	.4	99.9
	47	7	.1	.1	100.0
	48	3	.0	.0	100.0
	Total	6977	98.7	100.0	
Missing	System	89	1.3		
Total		7066	100.0		

Abstract Conceptualization

Raw Score		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	12	5	.1	.1	.1
	13	8	.1	.1	.2
	14	7	.1	.1	.3
	15	16	.2	.2	.5
	16	23	.3	.3	.8
	17	33	.5	.5	1.3
	18	67	.9	1.0	2.3
	19	100	1.4	1.4	3.7
	20	107	1.5	1.5	5.2
	21	120	1.7	1.7	7.0
	22	177	2.5	2.5	9.5
	23	201	2.8	2.9	12.4
	24	243	3.4	3.5	15.9
	25	245	3.5	3.5	19.4
	26	287	4.1	4.1	23.5
	27	301	4.3	4.3	27.8
	28	313	4.4	4.5	32.3
	29	334	4.7	4.8	37.1
	30	351	5.0	5.0	42.1
	31	335	4.7	4.8	46.9
	32	352	5.0	5.0	52.0
	33	351	5.0	5.0	57.0
	34	315	4.5	4.5	61.5
	35	351	5.0	5.0	66.5
	36	290	4.1	4.2	70.7
	37	280	4.0	4.0	74.7
	38	271	3.8	3.9	78.6
	39	251	3.6	3.6	82.2
	40	225	3.2	3.2	85.4
	41	201	2.8	2.9	88.3
	42	173	2.4	2.5	90.8
	43	144	2.0	2.1	92.8
	44	131	1.9	1.9	94.7
	45	114	1.6	1.6	96.3
	46	110	1.6	1.6	97.9
	47	84	1.2	1.2	99.1
	48	61	.9	.9	100.0
	Total	6977	98.7	100.0	
Missing	System	89	1.3		
Total		7066	100.0		

Active Experimentation

Raw Score		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	12	2	.0	.0	.0
	13	1	.0	.0	.0
	14	8	.1	.1	.2
	15	15	.2	.2	.4
	16	10	.1	.1	.5
	17	16	.2	.2	.7
	18	19	.3	.3	1.0
	19	51	.7	.7	1.7
	20	52	.7	.7	2.5
	21	98	1.4	1.4	3.9
	22	105	1.5	1.5	5.4
	23	114	1.6	1.6	7.0
	24	139	2.0	2.0	9.0
	25	150	2.1	2.1	11.2
	26	195	2.8	2.8	14.0
	27	238	3.4	3.4	17.4
	28	228	3.2	3.3	20.7
	29	282	4.0	4.0	24.7
	30	308	4.4	4.4	29.1
	31	333	4.7	4.8	33.9
	32	328	4.6	4.7	38.6
	33	317	4.5	4.5	43.1
	34	386	5.5	5.5	48.7
	35	418	5.9	6.0	54.7
	36	431	6.1	6.2	60.8
	37	370	5.2	5.3	66.1
	38	357	5.1	5.1	71.2
	39	360	5.1	5.2	76.4
	40	342	4.8	4.9	81.3
	41	312	4.4	4.5	85.8
	42	282	4.0	4.0	89.8
	43	241	3.4	3.5	93.3
	44	183	2.6	2.6	95.9
	45	148	2.1	2.1	98.0
	46	77	1.1	1.1	99.1
	47	46	.7	.7	99.8
	48	15	.2	.2	100.0
	Total	6977	98.7	100.0	
Missing	System	89	1.3		
Total		7066	100.0		

Abstract Conceptualization – Concrete Experience

Raw Score		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-35	1	.0	.0	.0
	-31	1	.0	.0	.0
	-30	2	.0	.0	.1
	-29	1	.0	.0	.1
	-28	3	.0	.0	.1
	-27	6	.1	.1	.2
	-26	5	.1	.1	.3
	-25	7	.1	.1	.4
	-24	10	.1	.1	.5
	-23	12	.2	.2	.7
	-22	20	.3	.3	1.0
	-21	12	.2	.2	1.1
	-20	19	.3	.3	1.4
	-19	23	.3	.3	1.7
	-18	31	.4	.4	2.2
	-17	32	.5	.5	2.7
	-16	36	.5	.5	3.2
	-15	53	.8	.8	3.9
	-14	54	.8	.8	4.7
	-13	65	.9	.9	5.6
	-12	81	1.1	1.2	6.8
	-11	73	1.0	1.0	7.8
	-10	86	1.2	1.2	9.1
	-9	87	1.2	1.2	10.3
	-8	114	1.6	1.6	12.0
	-7	121	1.7	1.7	13.7
	-6	131	1.9	1.9	15.6
	-5	129	1.8	1.8	17.4
	-4	162	2.3	2.3	19.7
	-3	140	2.0	2.0	21.7
	-2	165	2.3	2.4	24.1
	-1	186	2.6	2.7	26.8
	0	179	2.5	2.6	29.3
	1	210	3.0	3.0	32.4
	2	218	3.1	3.1	35.5
	3	193	2.7	2.8	38.2
	4	213	3.0	3.1	41.3
	5	192	2.7	2.8	44.1
	6	243	3.4	3.5	47.5
	7	206	2.9	3.0	50.5
	8	220	3.1	3.2	53.6
	9	225	3.2	3.2	56.9
	10	234	3.3	3.4	60.2

	11	216	3.1	3.1	63.3
	12	228	3.2	3.3	66.6
	13	231	3.3	3.3	69.9
	14	192	2.7	2.8	72.6
	15	197	2.8	2.8	75.5
	16	171	2.4	2.5	77.9
	17	149	2.1	2.1	80.1
	18	176	2.5	2.5	82.6
	19	181	2.6	2.6	85.2
	20	162	2.3	2.3	87.5
	21	133	1.9	1.9	89.4
	22	123	1.7	1.8	91.2
	23	118	1.7	1.7	92.9
	24	89	1.3	1.3	94.1
	25	90	1.3	1.3	95.4
	26	71	1.0	1.0	96.4
	27	64	.9	.9	97.4
	28	58	.8	.8	98.2
	29	29	.4	.4	98.6
	30	30	.4	.4	99.0
	31	19	.3	.3	99.3
	32	17	.2	.2	99.6
	33	15	.2	.2	99.8
	34	11	.2	.2	99.9
	35	3	.0	.0	100.0
	36	2	.0	.0	100.0
	Total	6976	98.7	100.0	
Missing	System	90	1.3		
Total		7066	100.0		

Active Experimentation – Reflective Observation

Raw Score		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-32	1	.0	.0	.0
	-28	3	.0	.0	.1
	-27	2	.0	.0	.1
	-25	5	.1	.1	.2
	-24	2	.0	.0	.2
	-23	19	.3	.3	.5
	-22	17	.2	.2	.7
	-21	19	.3	.3	1.0
	-20	32	.5	.5	1.4
	-19	28	.4	.4	1.8
	-18	40	.6	.6	2.4
	-17	40	.6	.6	3.0
	-16	37	.5	.5	3.5
	-15	63	.9	.9	4.4
	-14	77	1.1	1.1	5.5
	-13	89	1.3	1.3	6.8
	-12	92	1.3	1.3	8.1
	-11	89	1.3	1.3	9.4
	-10	119	1.7	1.7	11.1
	-9	114	1.6	1.6	12.7
	-8	127	1.8	1.8	14.5
	-7	148	2.1	2.1	16.7
	-6	138	2.0	2.0	18.6
	-5	137	1.9	2.0	20.6
	-4	156	2.2	2.2	22.8
	-3	168	2.4	2.4	25.3
	-2	169	2.4	2.4	27.7
	-1	155	2.2	2.2	29.9
	0	175	2.5	2.5	32.4
	1	171	2.4	2.5	34.9
	2	196	2.8	2.8	37.7
	3	170	2.4	2.4	40.1
	4	200	2.8	2.9	43.0
	5	228	3.2	3.3	46.2
	6	196	2.8	2.8	49.0
	7	209	3.0	3.0	52.0
	8	224	3.2	3.2	55.3
	9	214	3.0	3.1	58.3
	10	233	3.3	3.3	61.7
	11	214	3.0	3.1	64.7
	12	222	3.1	3.2	67.9
	13	192	2.7	2.8	70.7
	14	199	2.8	2.9	73.5

	15	209	3.0	3.0	76.5
	16	211	3.0	3.0	79.5
	17	184	2.6	2.6	82.2
	18	194	2.7	2.8	85.0
	19	155	2.2	2.2	87.2
	20	143	2.0	2.0	89.2
	21	147	2.1	2.1	91.3
	22	163	2.3	2.3	93.7
	23	104	1.5	1.5	95.2
	24	78	1.1	1.1	96.3
	25	64	.9	.9	97.2
	26	63	.9	.9	98.1
	27	39	.6	.6	98.7
	28	32	.5	.5	99.1
	29	25	.4	.4	99.5
	30	15	.2	.2	99.7
	31	6	.1	.1	99.8
	32	8	.1	.1	99.9
	33	7	.1	.1	100.0
	35	1	.0	.0	100.0
	Total	6977	98.7	100.0	
Missing	System	89	1.3		
Total		7066	100.0		

APPENDIX 2. Learning Style and Age

Age Range		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Concrete	<19	631	26.23	6.882	.274	25.69	26.77
	19-24	1155	25.66	6.484	.191	25.28	26.03
	25-34	1839	24.74	6.017	.140	24.47	25.02
	35-44	1573	25.22	6.237	.157	24.91	25.53
	45-54	1171	25.66	6.665	.195	25.28	26.04
	>55	398	26.13	7.219	.362	25.42	26.84
	Total	6767	25.39	6.437	.078	25.24	25.54
Reflective	<19	631	29.79	7.046	.281	29.24	30.34
	19-24	1155	28.84	7.285	.214	28.41	29.26
	25-34	1839	27.73	7.180	.167	27.40	28.06
	35-44	1573	27.68	6.790	.171	27.35	28.02
	45-54	1171	28.02	6.959	.203	27.62	28.42
	>55	398	27.67	7.030	.352	26.98	28.37
	Total	6767	28.15	7.079	.086	27.98	28.32
Abstract	<19	631	30.80	7.153	.285	30.24	31.36
	19-24	1155	30.83	6.958	.205	30.43	31.23
	25-34	1839	32.59	7.178	.167	32.27	32.92
	35-44	1573	32.66	7.356	.185	32.30	33.02
	45-54	1171	32.87	7.428	.217	32.45	33.30
	>55	398	34.19	7.663	.384	33.43	34.94
	Total	6767	32.28	7.313	.089	32.11	32.46
Active	<19	631	33.08	6.452	.257	32.57	33.58
	19-24	1155	34.62	6.542	.192	34.24	35.00
	25-34	1839	34.87	6.415	.150	34.57	35.16
	35-44	1573	34.40	6.768	.171	34.06	34.73
	45-54	1171	33.43	6.866	.201	33.04	33.82
	>55	398	32.01	6.482	.325	31.37	32.65
	Total	6767	34.13	6.654	.081	33.97	34.29
AC_CE	<19	631	4.54	11.922	.475	3.61	5.47
	19-24	1154	5.15	11.162	.329	4.51	5.80
	25-34	1839	7.85	11.188	.261	7.34	8.36
	35-44	1573	7.44	11.715	.295	6.86	8.02
	45-54	1171	7.22	12.163	.355	6.52	7.91
	>55	398	8.06	12.763	.640	6.80	9.31
	Total	6766	6.89	11.703	.142	6.61	7.17
AE_RO	<19	631	3.26	11.409	.454	2.36	4.15
	19-24	1155	5.81	11.649	.343	5.14	6.48
	25-34	1839	7.14	11.601	.271	6.60	7.67
	35-44	1573	6.72	11.580	.292	6.15	7.29
	45-54	1171	5.41	11.831	.346	4.73	6.09
	>55	398	4.34	11.139	.558	3.24	5.43
	Total	6767	5.99	11.656	.142	5.71	6.27

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Concrete	Between Groups	1647.824	5	329.565	7.995	.000
	Within Groups	278696.69	6761	41.221		
	Total	280344.51	6766			
Reflective	Between Groups	3019.612	5	603.922	12.152	.000
	Within Groups	336016.02	6761	49.699		
	Total	339035.63	6766			
Abstract	Between Groups	6085.709	5	1217.142	23.133	.000
	Within Groups	355729.44	6761	52.615		
	Total	361815.15	6766			
Active	Between Groups	4448.907	5	889.781	20.387	.000
	Within Groups	295080.66	6761	43.645		
	Total	299529.56	6766			
AC_CE	Between Groups	9818.528	5	1963.706	14.480	.000
	Within Groups	916731.00	6760	135.611		
	Total	926549.52	6765			
AE_RO	Between Groups	9489.806	5	1897.961	14.104	.000
	Within Groups	909809.15	6761	134.567		
	Total	919298.95	6766			

APPENDIX 3. Learning Style and Gender

Descriptives

Gender		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Concrete	M	3134	24.70	6.252	.112	24.48	24.92
	F	3203	26.04	6.525	.115	25.82	26.27
	Total	6337	25.38	6.426	.081	25.22	25.54
Reflective	M	3134	28.11	6.782	.121	27.87	28.35
	F	3203	28.29	7.357	.130	28.03	28.54
	Total	6337	28.20	7.079	.089	28.02	28.37
Abstract	M	3134	33.45	7.241	.129	33.20	33.71
	F	3203	31.00	7.133	.126	30.75	31.24
	Total	6337	32.21	7.290	.092	32.03	32.39
Active	M	3134	33.67	6.660	.119	33.44	33.91
	F	3203	34.65	6.584	.116	34.42	34.88
	Total	6337	34.17	6.639	.083	34.00	34.33
AC_CE	M	3134	8.75	11.548	.206	8.35	9.16
	F	3202	4.94	11.477	.203	4.55	5.34
	Total	6336	6.83	11.668	.147	6.54	7.12
AE_RO	M	3134	5.56	11.438	.204	5.15	5.96
	F	3203	6.38	11.836	.209	5.97	6.79
	Total	6337	5.97	11.647	.146	5.68	6.26

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Concrete	Between Groups	2872.164	1	2872.164	70.314	.000
	Within Groups	258769.956	6335	40.848		
	Total	261642.119	6336			
Reflective	Between Groups	49.364	1	49.364	.985	.321
	Within Groups	317430.710	6335	50.107		
	Total	317480.074	6336			
Abstract	Between Groups	9568.749	1	9568.749	185.273	.000
	Within Groups	327182.431	6335	51.647		
	Total	336751.180	6336			
Active	Between Groups	1511.274	1	1511.274	34.466	.000
	Within Groups	277778.087	6335	43.848		
	Total	279289.361	6336			
AC_CE	Between Groups	22993.472	1	22993.472	173.499	.000
	Within Groups	839434.413	6334	132.528		
	Total	862427.885	6335			
AE_RO	Between Groups	1070.165	1	1070.165	7.897	.005
	Within Groups	858488.492	6335	135.515		
	Total	859558.657	6336			

APPENDIX 4. Learning Style and Educational Level

Educational Level		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
Highest Degree						Lower Bound	Upper Bound
Concrete	Elem.	83	25.77	6.554	.719	24.34	27.20
	H. S.	2078	26.08	6.397	.140	25.80	26.35
	Univ.	2756	25.08	6.316	.120	24.85	25.32
	Grad.	1688	25.15	6.649	.162	24.83	25.47
	Total	6605	25.42	6.445	.079	25.27	25.58
Reflective	Elem.	83	29.65	7.440	.817	28.03	31.28
	H. S.	2078	28.88	7.062	.155	28.58	29.19
	Univ.	2756	28.09	7.014	.134	27.83	28.36
	Grad.	1688	27.27	7.044	.171	26.94	27.61
	Total	6605	28.15	7.069	.087	27.98	28.32
Abstract	Elem.	83	28.89	6.847	.752	27.40	30.39
	H. S.	2078	30.91	7.160	.157	30.60	31.22
	Univ.	2756	32.29	7.324	.140	32.02	32.57
	Grad.	1688	34.14	7.214	.176	33.80	34.48
	Total	6605	32.29	7.348	.090	32.11	32.46
Active	Elem.	83	35.69	6.802	.747	34.20	37.17
	H. S.	2078	34.00	6.505	.143	33.72	34.28
	Univ.	2756	34.52	6.602	.126	34.27	34.77
	Grad.	1688	33.44	6.815	.166	33.11	33.76
	Total	6605	34.10	6.644	.082	33.94	34.26
AC_CE	Elem.	83	3.12	11.460	1.258	.62	5.62
	H. S.	2078	4.83	11.447	.251	4.34	5.32
	Univ.	2755	7.20	11.679	.223	6.77	7.64
	Grad.	1688	8.99	11.827	.288	8.43	9.55
	Total	6604	6.86	11.754	.145	6.58	7.14
AE_RO	Elem.	83	6.04	12.445	1.366	3.32	8.75
	H. S.	2078	5.12	11.448	.251	4.63	5.61
	Univ.	2756	6.44	11.610	.221	6.00	6.87
	Grad.	1688	6.17	11.813	.288	5.60	6.73
	Total	6605	5.95	11.634	.143	5.67	6.23

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Concrete	Between Groups	1340.678	3	446.893	10.806	.000
	Within Groups	272997.555	6601	41.357		
	Total	274338.233	6604			
Reflective	Between Groups	2611.000	3	870.333	17.548	.000
	Within Groups	327386.205	6601	49.596		
	Total	329997.205	6604			
Abstract	Between Groups	10701.061	3	3567.020	68.073	.000
	Within Groups	345892.256	6601	52.400		
	Total	356593.317	6604			
Active	Between Groups	1458.381	3	486.127	11.062	.000
	Within Groups	290091.955	6601	43.947		
	Total	291550.336	6604			
AC_CE	Between Groups	17716.736	3	5905.579	43.571	.000
	Within Groups	894552.211	6600	135.538		
	Total	912268.947	6603			
AE_RO	Between Groups	2169.205	3	723.068	5.353	.001
	Within Groups	891650.670	6601	135.078		
	Total	893819.875	6604			

APPENDIX 5. Learning Style 3.1 Type and Educational Specialization

EDUCATIONAL SPECIALIZATION		LEARNING STYLE TYPE				Total
		Accom.	Diverge	Converge	Assim.	
Accounting	Count	39	26	42	42	149
	%	26.2%	17.4%	28.2%	28.2%	100.0%
Architecture	Count	2	0	1	4	7
	%	28.6%	.0%	14.3%	57.1%	100.0%
Business	Count	290	165	215	259	929
	%	31.2%	17.8%	23.1%	27.9%	100.0%
Communication	Count	54	17	20	19	110
	%	49.1%	15.5%	18.2%	17.3%	100.0%
Computer Sci./IS	Count	54	35	55	62	206
	%	26.2%	17.0%	26.7%	30.1%	100.0%
Education	Count	92	46	41	61	240
	%	38.3%	19.2%	17.1%	25.4%	100.0%
Engineering	Count	103	50	145	138	436
	%	23.6%	11.5%	33.3%	31.7%	100.0%
App. & Fine Arts	Count	23	20	12	20	75
	%	30.7%	26.7%	16.0%	26.7%	100.0%
Health	Count	82	48	59	72	261
	%	31.4%	18.4%	22.6%	27.6%	100.0%
Humanities	Count	28	24	19	40	111
	%	25.2%	21.6%	17.1%	36.0%	100.0%
Language	Count	8	4	5	9	26
	%	30.8%	15.4%	19.2%	34.6%	100.0%
Law	Count	29	16	23	42	110
	%	26.4%	14.5%	20.9%	38.2%	100.0%
Literature	Count	5	15	8	10	38
	%	13.2%	39.5%	21.1%	26.3%	100.0%
Medicine	Count	88	50	96	82	316
	%	27.8%	15.8%	30.4%	25.9%	100.0%
Other	Count	301	213	185	248	947
	%	31.8%	22.5%	19.5%	26.2%	100.0%
Phys. Education	Count	12	5	3	4	24
	%	50.0%	20.8%	12.5%	16.7%	100.0%
Psychology	Count	53	40	15	52	160
	%	33.1%	25.0%	9.4%	32.5%	100.0%
Science/Math	Count	53	35	88	110	286
	%	18.5%	12.2%	30.8%	38.5%	100.0%
Social Sciences	Count	68	51	38	72	229
	%	29.7%	22.3%	16.6%	31.4%	100.0%
Agriculture	Count	6	6	6	1	19
	%	31.6%	31.6%	31.6%	5.3%	100.0%
Total	Count	1390	866	1076	1347	4679
	%	29.7%	18.5%	23.0%	28.8%	100.0%