



Identifying predominant learning styles of students in diesel technology and practical nursing programs
by Richard Lee Gray

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Education
in Education

Montana State University

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Abstract:

This descriptive study addressed the problem that there was very little information available on the cognitive learning styles of students in specific two-year college vocational-technical programs. The preferred learning styles of students from two selected vocational-technical programs, Diesel Technology and Practical Nursing, of three selected colleges of technology in Montana were inventoried using the Kolb Learning Style Inventory in the Fall semester 2001. Follow up interviews with a few students and the lead instructors from the selected programs were conducted.

The results indicated that as a group of students in technical education the students in this study preferred a diverse set of learning styles. They did not indicate a preference for any one or combination of learning styles. When comparing the learning style preferences of the two programs; however, a statistically significant difference existed between them. The Diesel students' demonstrated a preference for the Converger and Accommodator learning styles, while the Nursing students' preferred the Diverger and Accommodator learning styles. The information from the student and faculty interviews noted that motivation and organization made a greater difference in students' ability to complete their program than did their learning style preference. The interviews, however, did suggest that knowledge of students' learning styles was helpful to students approach to learning and studying.

It was concluded in this study that the students in this study did not prefer only hands-on learning as previous research suggested, but were diverse in their learning styles. There was not any one or more learning style preferences that were statistically significant. A second conclusion found was that learning style preferences of the students in this study varied by program. Thirdly, it was concluded that a relationship may have existed between the students' learning style preferences and the instructional practices and expectations of the programs. Fourthly, the results of the study indicated that the knowledge of the learning style preferences by the students and faculty was beneficial to the students' approaches to learning.

IDENTIFYING PREDOMINANT LEARNING STYLES OF STUDENTS
IN DIESEL TECHNOLOGY AND PRACTICAL NURSING PROGRAMS

by

Richard Lee Gray

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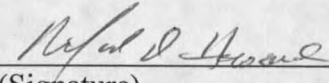
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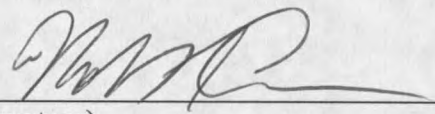
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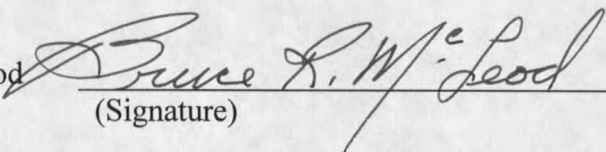
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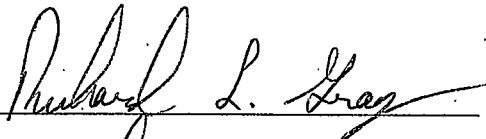
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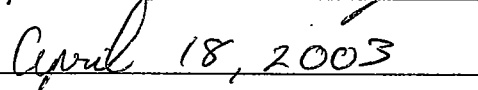
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ABSTRACT

This descriptive study addressed the problem that there was very little information available on the cognitive learning styles of students in specific two-year college vocational-technical programs. The preferred learning styles of students from two selected vocational-technical programs, Diesel Technology and Practical Nursing, of three selected colleges of technology in Montana were inventoried using the Kolb Learning Style Inventory in the Fall semester 2001. Follow up interviews with a few students and the lead instructors from the selected programs were conducted.

The results indicated that as a group of students in technical education the students in this study preferred a diverse set of learning styles. They did not indicate a preference for any one or combination of learning styles. When comparing the learning style preferences of the two programs; however, a statistically significant difference existed between them. The Diesel students' demonstrated a preference for the Converger and Accommodator learning styles, while the Nursing students' preferred the Diverger and Accommodator learning styles. The information from the student and faculty interviews noted that motivation and organization made a greater difference in students' ability to complete their program than did their learning style preference. The interviews, however, did suggest that knowledge of students' learning styles was helpful to students approach to learning and studying.

It was concluded in this study that the students in this study did not prefer only hands-on learning as previous research suggested, but were diverse in their learning styles. There was not any one or more learning style preferences that were statistically significant. A second conclusion found was that learning style preferences of the students in this study varied by program. Thirdly, it was concluded that a relationship may have existed between the students' learning style preferences and the instructional practices and expectations of the programs. Fourthly, the results of the study indicated that the knowledge of the learning style preferences by the students and faculty was beneficial to the students' approaches to learning.

CHAPTER 1

INTRODUCTION

Today's modern technology-dependent economy requires a growing number of technically trained workers. Tony Zeiss, President of Piedmont Community College, proclaimed that 75% of the U.S. workforce will require one to two years of skill training after high school (January, 2002). Technicians are employed in many occupations including, but not limited to, the transportation, small manufacturing, computer systems, and health care industries. They usually receive their education from some source of formal training after high school (Montana Department of Labor and Industry, 2002). This training is occupational specific, and the skills are taught in vocational technical education programs at community colleges, four-year colleges, private schools, and colleges of technology. In Montana, the primary role of colleges of technology is to prepare students for occupations requiring technical education beyond high school. The programs are one semester to two years in length (Montana Board of Regents, 2001). Typically, the educational programs are for technicians in computer support, health care, automotive maintenance, aviation maintenance, diesel maintenance, welding, machining, accounting, and construction (Montana Ambassadors, 2001).

In Montana, the colleges of technology are governed and accredited by the same bodies as four-year colleges and universities (Montana Board of Regents, 2001). In the last decade national accrediting associations, state legislatures, Congress, and state

governing boards have required higher levels of accountability from institutions of higher education, especially in student learning. Accrediting associations direct colleges to “understand, evaluate, and improve” academic programs (Commission on Colleges, 2002).

With this initiative, colleges have had to become more learner centered (Cross, 2001). Student outcomes, learning needs, and teaching practices are major focuses of college faculty and administrators. This initiative asks teachers to focus more on student preferences for approaching learning or learning styles. Teachers often find that “students will learn better when using [learning style] preferences in which they are successful” (O’Connor, 1997b, p. 4).

Learning styles are individual differences in learning, resulting from unique programming of human learning (Kolb, 1984). Curry and other researchers have conducted extensive research on learning styles, but there is much more to learn (Curry, 1990; Brown, 1998; Robotham, 1999). Researchers have found that people select occupations in which colleagues have similar learning styles (Kolb, 1984; Kolb, Boyatzis, & Mainemelis, 1999). They observed a predominance of learning styles in each of the different occupations studied. The research, however, has focused on occupations that require four-year degrees, i.e. engineering, economics, and social work. As a result, there is relatively little information available on the predominant learning styles in technical occupations (Hansen, 1995).

Some research has found that students in technical programs prefer hands-on activities (Orr, Park, Thompson, & Thompson, 1999), direct experience with equipment

(Smith, 2000), and working with the inanimate (Diaz, 1986). Joerger (1992) observed that technical college students preferred gaining new information by doing something and acting it out, but no relationship existed between learning styles and specific programs of study. Kolb categorized technology careers in the Converging type where people "are best at finding practical uses for ideas and theories" (Kolb, Boyatzis, & Mainemelis, 1999, p. 6). The limited research available on students in vocational technical programs indicated student preference for hands-on practical learning experiences.

If colleges are to become more learning centered, a greater understanding of the learner is required (Robotham, 1999). Teachers must teach to the full spectrum of learning styles (Felder, 1996), using a variety of methods and types of materials. Researchers in engineering education have found improvement in student learning by employing alternate forms of instruction beyond that of widespread use of lectures and content overloading (Ditcher, 2001). Having students teach some units of the course material increased the achievement of engineering students (Green, Kennedy, Mooney, Mooney, & Rosenbaum, 2001). In this study the predominance of learning style preferences of Diesel Technology and Practical Nursing students at the three selected Montana colleges of technology were analyzed.

Statement of the Problem

The problem addressed in this study is that there is little knowledge of the cognitive learning styles of students in specific two-year college vocational technical

programs. Researchers using Kolb's Learning Style Inventory have extensively inventoried people in several professional occupations including social work, counseling, managing, engineering, physics, economics, mathematics, and biology; however, very little work has been conducted in vocational programs (Kolb, 1984; Kolb, Boyatzis, & Mainemelis, 1999; Tucker, 1999). Existing research in vocational technical education has focused on learners in general, but little data exist on individual programs (Diaz, 1986; Joerger, 1992; Orr et al., 1999; Smith, 2000). To become more learner centered, instructors need to know their students. An understanding of students' learning styles, as well as abilities and motivations, is essential to understanding students' performances in the classroom (Biggs, 1978). With the inclusion of a broad spectrum of teaching methods and materials, knowledge of students' learning styles will help instructors to ensure they are meeting student needs (Felder, 1996).

Purpose of the Study

The purpose of this descriptive study was to identify the students' preferred learning styles in the Diesel Technology and Practical Nursing programs in selected Montana colleges of technology. These two programs were selected from the numerous occupational programs in Montana's colleges of technology because of readily accessible student populations in sufficient numbers. These programs also represented programs typical of the colleges of technology (Montana Ambassadors, 2001).

Statement of the Questions

The questions of this study address the problem that little information is available about the learning styles of students in specific two-year college vocational technical programs. These questions include the following:

1. What are the preferred learning styles of students in the Diesel Technology and Practical Nursing programs in selected colleges of technology in Montana?
2. Is there a difference in students' preferred learning styles in the two programs of the selected colleges of technology?
3. Do the students' learning style preferences vary with the instructional practices and expectations of the educational programs?

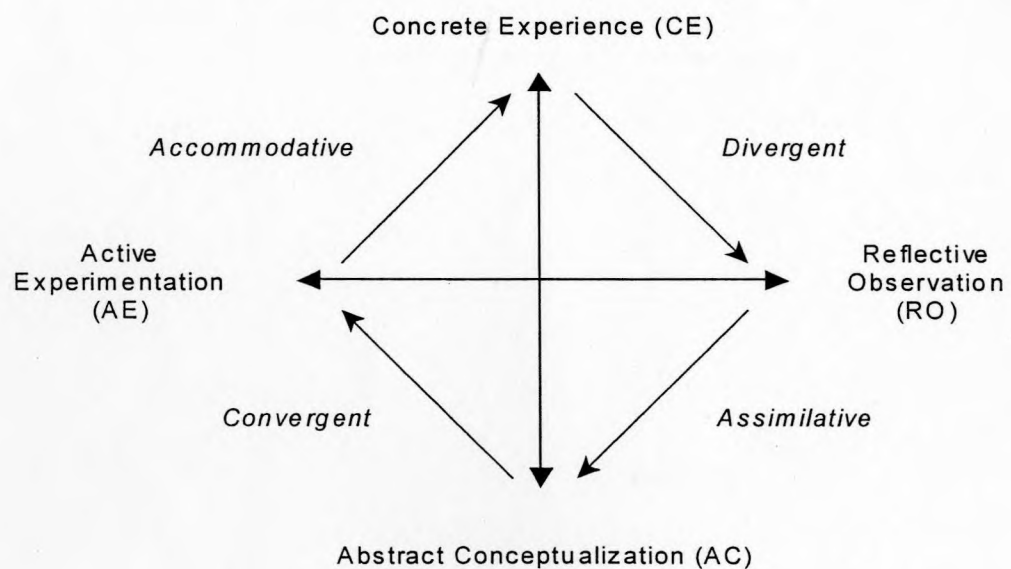
Framework of the Study

Learning styles can be measured in motivational characteristics, preferences for environmental aspects and social conditions, or individual cognitive processing styles (Curry, 1990). In this study cognitive styles were studied using Kolb's Learning Style Inventory. This inventory defines individuals' cognitive learning styles, but does not define motivational factors or preferences for the learning environment (Curry, 1983).

For purposes of this study, David Kolb's Experiential Learning Theory (ELT) was used as the theoretical framework for identifying cognitive learning styles. Since 1971 he has contributed significantly to the body of knowledge regarding learning styles in occupations. Kolb stated that, "Knowledge results from the combination of grasping experience and transforming it" (1984, p. 41). "Learning occurs through active extension

and grounding of ideas and experiences in the external world and through internal reflection about the attributes of these experiences and ideas” (Kolb, 1984, p. 52). In other words, people grasp information through concrete experience (CE) or abstract conceptualization (AC). They transform experience through reflective observation (RO) or active experimentation (AE). Kolb placed these concepts on continuums juxtaposed perpendicular to each other as shown in Figure 1. People who grasp knowledge through concrete experience and transform it via reflective observation have a Divergent learning style. Those who grasp knowledge through abstract conceptualization and transform it via reflective observation have an Assimilative style. Convergent knowledge is grasped through abstract conceptualization and transformed via active experimentation. Accommodative knowledge is grasped from concrete experience and transformed through active experimentation (see Figure 1).

Figure 1. Experiential Learning Theory Schematic



Significance of the Study

Very little research has been done to identify the predominant learning styles of students in different occupational programs taught at two-year colleges of technology (Hansen, 1995). With a knowledge of the learning style preferences of their students in the occupational programs, instructors may be able to focus more on how their students are learning and adapt teaching methods and materials accordingly. Kolb and other researchers have found that working people have learning styles similar to many of their colleagues. Social workers, artists, and journalists tend to have divergent learning styles. Scientists, researchers, and economists generally are assimilators. Engineers are usually convergent, and executives are often accommodative (Kolb, 1984; Kolb, Boyatzis, & Mainemelis, 1999). He suggested that divergers like brainstorming, using their imagination, and working in groups. Assimilators like to assimilate diverse facts into theoretical models, focusing upon validation of the ideas or theories themselves. They like "readings, lectures, exploring analytical models and having time to think things through" (1999, p 5). Convergers, when presented with a question or task, like to find the one correct answer. They prefer dealing with things rather than people and like laboratory assignments and practical applications. Accommodators are risk takers and accommodate well in new circumstances using trial and error. They like to work with others and do field work (1999).

Some research reveals that students enrolled in vocational technical programs relate best to the "physical, hands-on world and think in ways that are methodical, ordered, and predictable" (Orr et al., 1999, p. 2). This description fits Kolb's Converger

type learner. In this study the learning styles of students in Diesel Technology and Practical Nursing programs were identified, and the results of the study were compared to previous research to attempt to collaborate previous results. The instructors of the selected programs may use the results of this study to better understand their students and design presentation methods and materials accordingly. The results from this study may be helpful to instructors in other technical programs as well to evaluate relevance to their instructional environments. Furthermore, the results may be the foundation for further study of the learning styles of all students in vocational technical education.

Specialized accrediting agencies for programs such as nursing are sometimes prescriptive to content and methods of instruction in educational programs (Board of Nursing, 2002). Information from this study may prove valuable to the agencies' decisions in the rules and regulations of instructional programs.

Organization of the Study

To initiate this study, all students, including both first and second year classes of Diesel Technology and Practical Nursing in three selected colleges of technology, were asked to complete Kolb's Learning Style Inventory, Version 3 (Appendix A) in the Fall semester of 2001. The colleges used in this study were The University of Montana-Helena College of Technology (UM-H); The University of Montana-Missoula College of Technology (MCOT), and Montana State University-Billings College of Technology (MSUB). These colleges were chosen because each hosts both programs. The results were compiled and analyzed to identify the possible predominance of students' preferred

learning styles within the two contrasting occupational program types: Diesel Technology and Practical Nursing. Interviews were conducted with a small group of students and with the lead instructor for each of the six programs. Conclusions were drawn as to the predominance of preferred learning styles and the applicability of the results for the classroom instructors.

Definition of Terms

Learning Styles: Learning styles are defined as “the general tendency towards a particular learning approach displayed by an individual” (Robotham, 1999, p. 1).

Colleges of Technology: The colleges of technology in this study are public institutions under the Montana Board of Regents and have similar program requirements and funding mechanisms. They are post-secondary educational institutions funded through public tax revenues and student tuition that primarily teach technical occupations in one- and two-year programs. They usually award Certificates of Completion and Associate of Applied Science degrees with students’ successful completion of a prescribed set of courses (The University of Montana-Helena College of Technology, Montana State University-Billings, Montana State University-Great Falls College of Technology, The University of Montana-Missoula College of Technology, 2001).

Experiential Learning Theory Terms

Grasping New Information:

1. Concrete Experience: Perceiving new information through immersion in reality and feeling tangible qualities of the world by relying on one’s senses.

2. Abstract Conceptualization: Perceiving new information through thought and analysis using symbolic representation.

Transforming New Information:

3. Reflective Observation: Processing information by watching others involved in the same experiences and reflecting on what happens.
4. Active Experimentation: Processing information by actively trying out and doing things (Kolb, 1984).

Vocational Technical Education: In this study this phrase refers to educational programs in occupations requiring formal post-secondary training, but not necessarily a bachelor's degree. The programs are usually in service, repair and maintenance, fabrication, construction, and manufacturing. More specifically they refer to the technicians in the job market in the mechanical, health, and computer industries. Most of these occupations require a two-year college education, but the education and training can be gained in other formats. Technicians can gain their working knowledge and skills by training through labor union apprenticeship programs, on-the-job training, or special government training programs such as the Job Corp.

Limitations

The results of this study were limited to the identification of learning styles of Diesel Technology and Practical Nursing students in three colleges of technology in Montana. They have little generalizability to students in similar vocational technical education programs without further study. Automotive Technology students, for

instance, may have similar learning styles to those of Diesel Technology since they perform similar tasks, but confirmation of that possibility was outside the scope of this study.

Another limitation was that this study surveyed students in only one academic year. It did not study a cohort of students through their educational experience at the colleges of technology from their entrance to graduation.

A third limitation of this study was a limited focus on the impact of the knowledge of students' learning styles on student learning. The student interviews revealed that students' knowledge of personal learning styles was useful to student learning, but a statistical analysis of this phenomenon was not conducted in this study.

Summary

The focus of instruction in the colleges of technology is becoming more learning centered based on how well students are learning, which is consistent with other institutions of higher education across the country. The research problem as stated in this chapter is that there is a lack of information about preferred learning styles in specific technical occupations. When designing methods and materials for instruction, teachers need to know as much as possible about their students to include learning styles preferences. The purpose of the study was to identify preferred learning styles of students in Diesel Technology and Practical Nursing programs. Kolb's Experiential Learning Theory was used in this study to address the study's questions. Students' preferred learning styles were identified as Convergent, Divergent, Assimilative, or

Accommodative. This information can be used by instructors of these students to adapt teaching methods and materials to learning styles in their classrooms. The study was organized to identify preferred learning styles in two technical programs in three colleges of technology in Montana. This will be useful to instructors in the study's programs, but results of the research will have limited generalizability to other programs.

CHAPTER 2

LITERATURE REVIEW

The literature in learning styles contains several learning style theories, and Lynn Curry categorized them as learning styles defined by environmental conditions, social conditions, engagement levels, and cognitive skills (1983). The cognitive approaches to learning were found to depend more upon an individual's innate characteristic than upon environmental influences (Curry, 1983). In particular, Curry classified Kolb's Learning Style Inventory as a measurement of cognitive learning styles (1990). Kolb's Experiential Learning Theory (ELT) was chosen for this study because of its wide acceptance as a useful framework for identifying predominant cognitive learning styles in formal educational settings and various occupations (Kolb, Boyatzis, & Mainemelis, 1999).

In this chapter the theoretical and structural foundation of ELT is discussed along with the various factors that have been found to influence an individual's learning style. The strength of the reliability and validity of the ELT Learning Style Inventory instrument is discussed. At the end of this chapter, other notable learning styles are described and relationships to Kolb's ELT are discussed.

Experiential Learning Theory

ELT is based on the theoretical constructs of educational theorist John Dewey, social psychologist Kurt Lewin, and developmental psychologist Jean Piaget. Kolb drew heavily on John Dewey's writings in the development of ELT. Dewey saw value in the intimate relationship between people's actual experiences and their formal education; thus, he advocated for experiential learning experiences in education such as apprenticeships, internships, and field projects (Dewey, 1950; Kolb, 1984). Many educators since John Dewey have concluded that "people do learn from their experiences" (Kolb, 1984, p. 6). Kurt Lewin consistently advocated for the integration of theory and practice in his work on organizational behavior. He found that tension between concrete experience and analytic detachment enhanced learning. He also theorized that subjective experience was as critical to learning as logical analysis (Lewin, 1936; Kolb, 1984). Jean Piaget found in his work on cognitive-development that intelligence was not an innate characteristic, but a product of the person's interaction with his or her environment (Piaget, 1938). His work and the parallel work of Jerome Bruner led to the development of curricula based on student experience. Instruction in these curricula became more discovery-based capitalizing on interaction with the real-world environment (Bruner, 1978).

Extensions of Piaget's theory of cognitive-development by such theorists as William Perry, Lawrence Kohlberg, and Jane Loevinger recognized "that learning and development are lifelong processes" (Kolb, 1984, p. 15). In ELT, Kolb conceived learning as a process of forming and re-forming ideas through experience. Learning is a

continuous process of re-learning through experiencing, reflecting, conceptualizing and taking action. "Learning is the major process of human adaptation" (Kolb, 1984, p. 32).

As Kolb first created the ELT conceptual framework in 1976, he found a difference in people's cognitive styles of learning or their preference for the way they initially grasp information and the way that they transform information into working concepts and theories. For Kolb, individuals' cognitive approaches to learning were more defining of overall learning styles than motivations, type of intelligence, and personality characteristics (1984).

According to ELT, individuals receive or grasp new information by either experiencing it or by symbolic representation. New information is transformed or internalized by individuals through internal reflection or by active manipulation of the external world. In Kolb's terms people grasp information on a continuum between Concrete Experience and Abstract Conceptualization, and they transform information on a continuum between Reflective Observation and Active Experimentation. The two continuums are positioned perpendicular to each other (Figure 1) to form a circle of learner type combinations (Kolb, 1984).

Kolb grouped learners as Divergers, Assimilators, Convergers, and Accommodators. He described Divergers as people who grasp experience concretely at first then transform it through reflective observation into a conceptual framework. They are good at brainstorming and using their imaginations through the rest of the learning cycle. These people like practical experiences and need to know how these experiences will help them in the future. Divergers tend to be people-oriented and emotional, and they often major in Arts, History, English, Psychology, and Political Science. They tend

to go into professions in social service, arts, and communications, and value relationships, helping others, and making sense of their world (Kolb, 1984, Kolb, Boyatzis, & Mainemelis, 1999; O'Connor, 1997a; Universal Educator, 2000).

Assimilators grasp experience abstractly at first then transform it through reflective observation. They like to assimilate diverse facts into theoretical models, focusing upon validation of the ideas or theories themselves. These people learn from observation, looking at different perspectives, and looking for the meaning of things. They are analytic learners and like well-ordered, logical presentations. Assimilators often major in Mathematics, Chemistry, Economics, Sociology, and Justice. They tend to pursue professions in the sciences, information, or research and they value thinking skills: information gathering, information-analysis, and theory building (Kolb, 1984; Kolb, Boyatzis, & Mainemelis, 1999; O'Connor, 1997a; Universal Educator, 2000).

Convergers grasp experience abstractly at first, but then move to process it through active experimentation. When presented with a question or task, they move quickly to find the one correct answer. They are relatively unemotional and prefer dealing with things rather than with people. These people learn from logical analysis, planning, and acting on intellectual understanding. They are common-sense learners. Convergers often major in Engineering, Physics, and Physical Science. They tend to enter professions in fields of technology, economics, and environmental science. They like bench engineering and production that require technical and problem-solving skills and value decision-making, quantitative analysis, use of technology, and goal setting (Kolb, 1984; Kolb, Boyatzis, & Mainemelis, 1999; O'Connor, 1997a; Universal Educator, 2000).

Accommodators grasp experience concretely at first, but then move to process it through active experimentation. They are risk-takers and accommodate well in new circumstances using trial and error, but are often impatient and even aggressive. When confronted with a theory that does not match the facts as they see them, they discard the theory. These people like demonstrations and chances to explore new knowledge and skills. Accommodators often major in Business and enter careers in organizations (management, public finance, educational administration) and business (marketing, government, human resources). They are often the executives and value action, leadership, and initiative (Kolb, 1984; Kolb, Boyatzis, & Mainemelis, 1999; O'Connor, 1997a; Universal Educator, 2000).

Individuals in each of Kolb's learner typologies have unique learning preferences depending on their combination of strengths on both continuums. Their preferences, however, can change over time depending on maturity and their learning environment (Kolb, 1984).

Factors that Shape Learning Styles

Learning styles are shaped and influenced by people's personality and their contextual environment. Kolb's examination of research over a period of three decades found that personality types, educational specialization, professional career, job role, and the current learning task influenced the learning style an individual employs for learning (Kolb, Boyatzis, & Mainemelis, 1999). Other theorists support Kolb's findings: Healey and Jenkins found that learning styles are flexible structures, not solely defined by innate personality traits. Individual preferences to learning are consistently characteristic of the

individual, but are only one aspect of learning styles (2000). College education and occupational careers progressively shape people's learning styles (Kolb, Boyatzis, & Mainemelis, 1999).

Nulty and Barrett (1996) suggested that students selected learning styles similar to other students in the first stages of their college education, but often selected learning styles more related to their discipline in the final stages. The results from a study by Ehle and Price (1999) showed that 44% of two-year college students scored as concrete learners on the Group Assessment of Logical Thinking (GALT) instrument, but 54% of four-year college students scored as formal learners. The results showed similar patterns whether or not the students were in general education classes or applied health. Concrete learners in the GALT typology were considered to be at the beginning stages of learning development, while formal learners were seen as more advanced (Ehle & Price, 1999).

Results from longitudinal studies confirmed that students as a group enter college with predominant preferences for some learning styles over others, but they learned to work in other styles as they developed their learning skills (Kolb, 1984). The ability to learn in more than one style enabled students to work in a variety of situations (Wong, 1991). Richard Felder found that "most people and presumably most students in science classes are visual learners while the information presented in almost every lecture course is overwhelmingly verbal" (1993, p. 288). Learners are often required to adapt to the learning situation. "Gardner suggests that virtually everyone has the capacity to develop (multiple) intelligences to a reasonably high level of performance if given the appropriate encouragement, enrichment, and instruction" (Armstrong, 1994, p. 11). Andrews found in his studies of mapping of brain electrical activity that there are "clear patterns of

differentiated brain function of individuals with putative learning style differences.... furthermore, individuals taught various strategies for learning are able to modify their learning approach, their brain activity and their learning success" (1989, p. 2).

"Individuals can learn in situations that conflict with personal preferences, but they may not learn as much, as well, or as enjoyably as they will in their preferred conditions" (Cranton, 1989, p. 30). Students may adapt to other learning styles, but continue to have preferences.

Many studies show that predominant preferences for learning styles exist in occupations and four-year college majors. Kolb (1984) found that American students studying geography favored an Assimilative learning style. In 1973, Biglan as cited by Kolb suggested that education majors, including vocational technology majors, scored as Accommodators on Kolb's Learning Style Inventory (Kolb, 1984). Kolb placed nurses and technicians in the Assimilative quadrant of learning styles (Kolb, 1984).

Matthews conducted a study with a population of approximately 2,000 college and university students and 6,000 high school students in South Carolina using the Canfield model as the measuring instrument (1995). She found that first-year college students preferred social and conceptual styles on the Canfield Learning Styles Inventory (Matthews, 1995). The social learner in the Canfield model is described as having a preference for extensive interaction and for group work. The conceptual learner preferred the lecture-teaching mode (Canfield, 1976). Matthews found, however, differential preferences by students in different major fields of study. She suggested that math majors preferred the applied category with activities directly related to real world experience. Majors in the humanities, social science, education, and business preferred

the conceptual category. Learners tended to select occupations in which colleagues have similar learning styles or adopt the predominant learning style of the people in the occupation (Kolb, 1984).

Some research indicated that there is a difference of learning style preferences between genders. Males preferred the inanimate, whereas females preferred the qualitative and people environments (Diaz, 1986). The National Association of Secondary School Principals (NASSP) studies revealed that girls were more attentive to social context and boys were better at manipulating three-dimensional, inanimate objects (1979). This information implied that girls generally preferred the Diverger (people-oriented) type learning style from Kolb's ELT and boys preferred the Converger (technically-oriented) type. Other research, however, did not confirm that assumption (Jones, 2000).

Vocational Technical Education

The research in vocational technical education generally suggested that students have a preference for technical skills using the inanimate. Kolb's studies placed people in technical jobs, those jobs that require technical and problem-solving skills, in the Convergent learning orientation (1999). Diaz confirmed Kolb's placement in her 1986 study of community college career and transfer students. She found that career students preferred working with the inanimate more than did the transfer students. Kolb's Convergent type learners preferred to deal with technical tasks, which implied preference for the inanimate. Orr et al. found the predominant learning style to be concrete sequential on the Gregorc Style Delineator in her study of a representative sample of

postsecondary students in business education, health occupations, and trade and industrial programs in institutes in Arkansas (1999). Concrete sequential students preferred hands-on activities. In Smith's study, vocational learners preferred direct experience using equipment, tools, or processes (2000). However, Joerger found a contrasting result from a study of students in a Minnesota technical college and a Minnesota community college. In that study, technical college students scored predominantly in the Diverger category (1992). Joerger also found no relationship between students' learning styles and their programs of study.

Validity/Reliability

Kolb and other researchers have studied learning styles using Kolb's theoretical constructs since 1971, and amassed a formidable database of support for ELT. More than 990 studies have been conducted using ELT (Kolb, Boyatzis, & Mainemelis, 1999). Kolb first built an instrument to inventory learning styles in 1976, but revised it with the latest version in 1999 titled Learning Styles Inventory-Version 3 (LSI-3). The LSI-3 was normed on 1,446 adults between the ages of 18 and 60, 638 of whom were men and 801 were women. The sample was ethnically diverse and represented a wide range of career fields. The test-retest reliability for LSI-3 ranged from 0.93 to 0.99 with the time between tests of eight weeks. Internal consistency ranged from 0.53 on the active scale to 0.74 on the abstract scale. The initial sample for the test-retest was 711 with a replication sample of 1052 (Boyatzis, Kolb, & Kolb, 2001). In 1991, Hickox reviewed the studies testing the validity of Experiential Learning Theory and the Learning Styles Inventory, and concluded that 83.3% of the hundreds of studies "provided support for the

validity of ELT and the Learning Style Inventory” (Hickcox, 1991; Boyatzis, Kolb, & Kolb, 2001).

Commonalities

There are many different learning style theories with associated instruments other than Kolb’s Experiential Learning Theory (ELT) and the Learning Style Inventory. Some of the more notable theorists are Canfield with the Canfield model and Gardner with a multiple intelligences model (O’Connor, 1997a). Jung’s personality theory is interpreted through the Myers-Briggs Type Indicator and a shortened version called the Kiersey Temperament Sorter (O’Connor, 1997a).

The Canfield model focuses on the affective component of learning styles. The model surveys what motivates the student to learn and perform well. Canfield’s model is an instructional-preference approach based on Maslow’s hierarchy of needs and McClelland’s notion of achievement motivation (Canfield, 1988; Matthews, 1995). Environmental as well as motivational factors are assessed to determine the student’s preference when approaching the learning task.

Although Canfield’s model is categorized as a measurement of affective components of learning styles, there are some similarities to Kolb’s cognitive model. Canfield’s social learner likes working with people; Kolb’s Divergers are people-oriented. The conceptual learner prefers lecture type teaching; Kolb’s Assimilator desires a well organized, logical presentation. Canfield’s applied learner enjoys real-world experiences; Kolb’s Converger prefers to experience learning (Canfield, 1988; Kolb, 1984; Kolb, Boyatzis, & Mainemelis, 1999).

Howard Gardner (1999), on the other hand, theorized that people can be categorized into one or more of at least eight basic intelligence types: linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, and naturalist. Each of the intelligences has particular sensitivities to words, numbers, spatial orientation, body awareness, sounds, rhythms, people, and the natural world. For Gardner, people approach learning with strengths in unique blends of the basic intelligences. People may be strong in one of the intelligences or in a combination of one or more (Armstrong, 1994; Gardner, 1999). Gardner's work supported Kolb's findings that people tend to mature in their learning styles as their world becomes more specialized.

The Myers-Briggs Type Indicator (MBTI) categorizes individuals by four bipolar concepts of personality types: extraversion versus introversion, sensing versus intuition, thinking versus feeling, and judgment versus perception (O'Connor, 1997a). Kolb correlated the LSI with the MBTI. He found that the extraversion/introversion continuum on the MBTI correlated with the active/reflective continuum on the LSI. The feeling/thinking from the MBTI correlated with the concrete/abstract. Table 1 delineates the correlation of the LSI and the MBTI learning types (Kolb, Boyatzis, & Mainemelis, 1999).

Table 1. Correlation of LSI and MBTI Learning Types

| LSI | Learning Types | MBTI |
|--------------|----------------|-----------------------|
| Diverger | | Introverted/Feeling |
| Assimilator | | Introverted/Intuitive |
| Converger | | Extraverted/Thinking |
| Accommodator | | Extraverted/Sensing |

