

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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This thesis has been read by each member of the graduate committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Date April 18, 2003

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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?

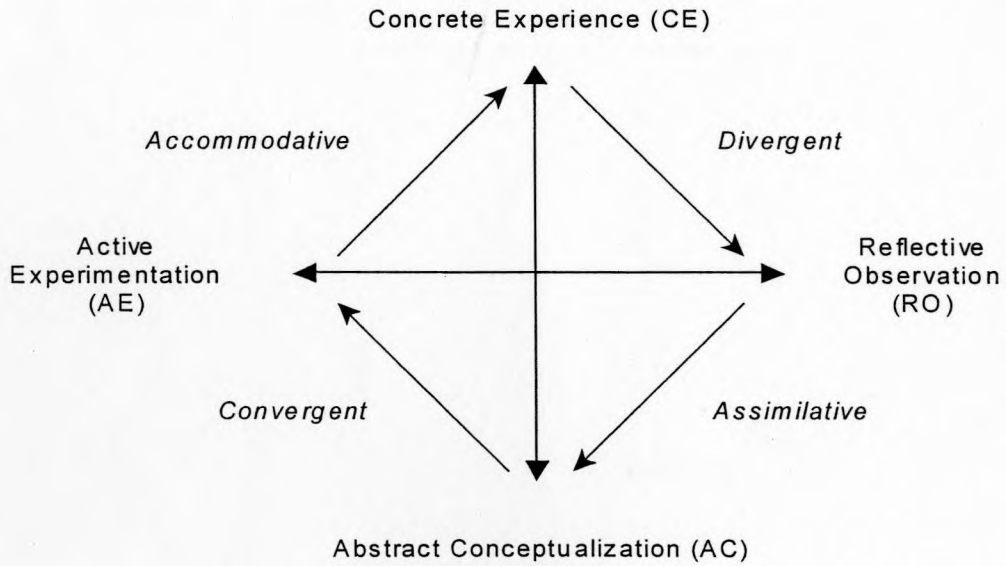
Framework of the Study

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

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

Summary

From the writings of Dewey, Lewin, Piaget, and other learning theorists, Kolb created his Experiential Learning Theory (Kolb 1984; Kolb, Boyatzis, & Mainemelis, 1999). According to Kolb, people learn through their experiences whether the experiences are real and concrete or symbolic representations. Learners fall into one of four types: Divergers, Assimilators, Convergers, or Accommodators. Kolb and other researchers have suggested that learning styles can be flexible with influence from personality uniqueness and contextual setting of the learning environment. There is strong evidence that individuals may prefer learning styles similar to their colleagues by either selecting the occupational group or by adapting to the predominant learning style in the occupation. Kolb used his Learning Style Inventory (LSI) to document trends in the learning styles of college majors and people at work. Version 3 of the LSI has high test-retest reliability and strong validity. Although there are several different learning style theories, Kolb's ELT/LSI has wide usage and acceptance in the educational arena and occupational studies. His research indicated a strong relationship of the learner typologies in his ELT to the personality types identified on the MBTI. With the long-term and substantial record of research using the LSI and its strong reliability and validity data, the Kolb LSI was determined to be the appropriate instrument to use for inventorying student's learning styles in this study.

CHAPTER 3

METHODOLOGY

This chapter explains the method used to study the research problem of limited information available on learning style preferences in vocational education at the postsecondary level. It describes the selection of students for the study and the instrument used to inventory students' preferred learning styles. Finally, this chapter reports the methods used to analyze the data and the findings from the results.

The purpose of this descriptive study was to identify the preferred learning styles of students in the Diesel Technology and Practical Nursing programs in selected colleges of technology in Montana. This study addressed the research problem that there is little information available on learning styles of students in two-year college occupational programs. The preferred learning styles of students in the Diesel Technology and Practical Nursing programs in selected colleges of technology in Montana were identified.

Participant Selection

All students in the Diesel Technology and Practical Nursing programs at the three colleges of technology in Montana were asked to participate in this study. These students were pursing Associate of Applied Science Degrees and were either in their first or second year of the program of study. They were all commuter students meaning that

none of the selected campuses had resident facilities.

Three colleges of technology were selected for this study. They were The University of Montana-Helena College of Technology (UM-H), The University of Montana -Missoula College of Technology (MCOT), and the Montana State University-Billings College of Technology (MSUB). The Helena and Missoula colleges are affiliated with The University of Montana, and the Billings college is within the Montana State University. Only one of the colleges, UM-H, is a stand-alone college. At the time of this study it was the Helena College of Technology of The University of Montana. Its name has since changed. The Missoula College of Technology is a college within The University of Montana-Missoula and the Billings college is a college within Montana State University-Billings, an affiliate campus of Montana State University (Montana University System, 2001).

The colleges of technology (COTs) in Montana are two-year colleges with the primary mission of providing post-secondary occupational education (Montana Board of Regents, 2001). The COTs award Associate of Applied Science Degrees (AAS) that prepare graduates for employment. There are opportunities for transfer, but transfer is a secondary objective of the AAS programs. The colleges of technology also offer Certificates of Completion and non-credit occupational training. Recently, the COTs expanded their missions toward more comprehensiveness with transfer associate degrees and developmental education courses. All of the public universities and colleges and the colleges of technology are governed in Montana by a board of regents that employs a Commissioner of Higher Education and support staff (Montana Board of Regents, 2001).

The students participating in this study were adults 17 to 54 years of age who chose to enter a college of technology in Montana for the purpose of getting an AAS degree or Certificate of Completion in Diesel Technology or Practical Nursing. Students enrolling in Montana's colleges of technology are required to have a high school diploma or GED. If they do not have a high school diploma and are 16 or older, they must have proof of ability to succeed, such as a recommendation from a high school principal (The University of Montana-Helena College of Technology, 2001).

Diesel Technology students are taught how to maintain diesel equipment that includes over-the-road trucks, agricultural equipment, and industrial diesel equipment. They usually gain employment in truck repair businesses, farm equipment dealerships, farms, mines, and construction companies. Very few pursue higher-level college degrees.

Practical Nursing students are taught how to care for patients in nursing homes, home health care, hospitals, and doctor's clinics. Their skills are in high demand and they easily find employment in their communities, state or region. Many of these students enter the nursing programs with the intention of transferring into two- and four-year registered nursing programs.

Although the respective programs have similar courses at each college, there are different degrees. Two AAS degree options for Diesel students presently exist at UM-H: Truck Diesel and Agriculture and Industry Diesel. A Certificate of Completion is available in each of the options. The difference between an AAS degree of 72 credits and a certificate of 66 credits in Diesel at UM-H is in the number of General Education credits students are required to take. The AAS degree requires 12 credits of General

Education, while the Certificate requires six credits (The University of Montana-Helena College of Technology, 2001). The students take their first year of General Diesel courses as a group, then choose their option for the second year. Three instructors were present in the program for 35 students in 2001-2002, of which 28 students participated in the study.

Montana State University-Billings College of Technology (MSUB) awards students in the Diesel program a Certificate of Completion. There is not an option for an AAS degree, but the number of credits is the same as the AAS at UM-H, including the number of General Education credits (Montana State University-Billings College of Technology, 2001). For 2001-2002, Billings had 22 students with one instructor.

The Missoula College of Technology (MCOT) offers an AAS degree in the diesel program called Diesel Equipment Technology. Eleven of the credits are in General Education. MCOT had 30 students with two instructors (The University of Montana-Missoula College of Technology, 2001). All of the MCOT and MSUB Diesel students participated in the study.

The Practical Nursing program at UM-H was in its third year of offering an AAS degree at the time of the study with 48 students in pursuit of the 72 credits required for graduation. A new course sequence started in the fall of each year, but not in the Spring semester. Students were required to take 15 General Education credits, and they had the option to choose college transfer General Education Courses like Biology, English Composition, and Public Speaking. There were two full-time instructors and one three-quarter-time instructor in the program along with a program chair who performed half-time administrative duties.

In Billings, Practical Nursing students numbered 61 in 2001-2002 with five instructors. They awarded an AAS degree upon successful completion of the required 70 credits, 12 of which are in General Education. The Billings and Missoula programs both started new course sequences in the spring as well as in the fall semester.

The Missoula COT had 51 students enrolled in nursing with two instructors. Ten instructors were listed in an umbrella Health Occupations Department, which housed the Practical Nursing Program. Many health care courses overlapped. The Practical Nurses had a 68-credit Certificate of Completion with five credits in General Education (The University of Montana-Missoula College of Technology, 2001).

As shown in Tables 2 and 3, 80 Diesel Technology and 160 Practical Nursing students participated in the study. The Diesel Technology students were predominantly young males 18-22 years of age. The Practical Nursing students were predominantly female between the ages of 17 and 27. There were a substantial number of older students in the Nursing programs with the oldest student being 54 years old.

Table 2. Numbers of Diesel Technology Students by Year, Gender, and Age

Diesel Technology										
	Yr. In Program		Gender		Age Groups					Totals
	First	Second	M	F	18-22	23-27	28-32	33-37	38+	
UM-H	15	13	28		23	3	1		1	28
MSUB	15	7	22		16	3	2	1		22
MCOT	9	21	29	1	21	4	3		2	30
Totals	39	41	79	1	60	10	6	1	3	80

Table 3. Numbers of Practical Nursing Students by Year, Gender, and Age

	Practical Nursing									
	Yr. In Program		Gender		Age Groups					Totals
	First	Second	M	F	18-22	23-27	28-32	33-37	38+	
UM-H	30	18	6	42	19	11	5	4	9	48
MSUB	35	26	3	58	16	10	10	7	16*	61
MCOT	37	14	3	48	15	13	7	7	9	51
Totals	102	58	12	148	50	34	22	18	34	160

*Two MSUB Nursing students did not record their age

Research Design

The learning styles of students from Diesel Technology and Practical Nursing programs at three selected Montana colleges of technology were identified in this study. These two programs were selected because of the readily accessible and substantial number of students. The Nursing and Diesel programs were also core programs of the colleges of technology, since they were in the health and mechanical repair areas.

A comparison was made of student learning style preferences as one group and by subgroups to include the two selected programs, the three selected colleges, students' year in college, and gender. The subgroups were compared and analyzed for differences in students' learning style preferences.

In addition, students and faculty were interviewed as a follow up to the inventory in an attempt to better understand the results. A number of students who had taken the Inventory were interviewed to gather in-depth information about their perceptions of their learning style and its application to their program studies. The students were selected for the interviews using a convenience sampling strategy (Gay, 1996). Specifically, the interviewed students were those who were able to arrange their

schedules for the interviews and were willing to participate. Also, the Department Chair or the lead faculty member from each of the programs was interviewed to glean insights about the potential relationship of students' learning style preferences to the instructional practices and expectations within programs.

Based on the literature, an interview protocol was developed for each of the interview groups, students and department heads. A faculty member in the Adult and Higher Education faculty at Montana State University-Bozeman reviewed the questions in the protocols. Recommendations from this review were incorporated in the student protocol. Two pilot interviews were then conducted with students in the Nursing and Diesel Mechanics programs to test the appropriateness of the wording of the questions. Comments from the students during the pilot interviews resulted in additional refinements to the questions. The questions were redesigned to be more open-ended and related to classroom experiences rather than yes or no questions about learning styles. With the revised questions, the students were more responsive. The student interviews were conducted between March 1 and May 30, 2002 using hand-written notes as the recording method. Six of the ten students were interviewed individually. Four were interviewed in pairs. The four students interviewed in pairs were given concurrent time from class to participate in the interview. Two Nursing students from Helena were interviewed together as well as two Diesel students from Missoula. Once the interview responses were transcribed from the notes taken during the interviews, they were submitted to the interviewees for verification of accuracy of the comments. The students did not submit changes in the comments. The Student Interview Protocol can be found in Appendix F.

A pilot interview was not conducted for the faculty interviews. The questions were developed in collaboration with a faculty member in the Adult and Higher Education faculty at Montana State University-Bozeman with the intent to gain information about the relationship of students' learning style preferences to instructional practices and expectations. The faculty interviews were conducted between May 1 and June 30, 2002 using hand-written notes for recording. As the researcher, the interviewing person served as the Associate Dean of UM-Helena. Once the interview responses were transcribed from the notes taken during the interviews, they were submitted to interviewees for verification of accuracy of the comments. The Director of Nursing from Helena noted that all of the Helena Nursing faculty used a variety of teaching methods in the classroom. She also made a change in the department faculty tenure from one to two years to two to three years. The remaining faculty members did not submit any changes in the interview transcripts.

Follow-up questions were conducted with the three Nursing Directors. The statistical analysis of the Nursing students by college reflected a statistically significant difference in the learning style preferences of the Helena Nursing students from the Missoula and Billings Nursing students. The Nursing directors were asked to hypothesize on the statistical differences in learning style preferences of the three Nursing programs. When compared to the Missoula and Billings Nursing programs, the results of Helena Nursing students reflected a statistically significant preference for the Diverger and Accommodator learning styles. In answer to the follow-up question, the Program Directors did not have a definitive response. Follow-up questions were not asked of the Diesel faculty. For the purposes of this study, the information gained from

the interviews with the Diesel faculty seemed sufficient. The Faculty Interview Protocol can be found in Appendix G.

Data Collection

Procedurally, the selected students completed Kolb's Learning Style Inventory (LSI) in the Fall Semester of 2001. The students were asked to self-score their responses using Kolb's Cycle of Learning form (Appendix B) and the Personal Information form (Appendix C). Using Kolb's Learning-Style Grid (Appendix D), the students were asked to identify their learning style type. Finally, on the Personal Information page (Appendix C), students commented on the fitness of the indicated learning style type to their conception of themselves. The descriptions of each learning style type were given to the students on the Learner Types page (Appendix E). This question was asked in order to give an indication of the student's perception of the validity of the instrument.

Analysis

Frequency comparisons and Chi-Square Goodness of Fit and tests of independence were conducted to analyze the learning style preferences for all students and several subgroups. Comparisons of learning style preferences were made according to program, college, programs within colleges, year in college, year within programs, and by gender. The Chi-Square Goodness of Fit test was used to analyze the significance of the frequencies of the learning style types for all students as one group. An equal distribution of the type categories was used as expected frequencies for the chi-square tests. The Chi-Square test of independence was used to analyze the subgroups using expected frequencies based upon the collected data. Conclusions were drawn as to the

predominance of any one learning style in the two selected occupational programs.

Information from the student and faculty interviews was analyzed in regard to the results of the data and review of the literature. Conclusions were determined based upon potential relationships between students' learning style preferences and the reported instructional practices and expectations of the educational programs.

Conclusions for the study were made only about the predominance of learning styles in Diesel Technology and Practical Nursing students in the three selected colleges of technology. These conclusions have implications for the Diesel Technology and Practical Nursing programs in the selected colleges, but have limited generalizability to other colleges or other occupational programs in the same occupational clusters, such as automotive technicians for diesel and medical assistants for nursing.

Summary

This study was designed to address the research problem of having little information about the cognitive learning styles of students in college level occupational programs. All students in the Diesel Technology and Practical Nursing programs in three selected Montana colleges of technology were administered Kolb's Learning Style Inventory in the fall of 2001. The data were analyzed using Chi-Square test of independence for statistical significance of preferences for any one or more of the four learning-style types of Kolb's Experiential Learning Theory. Conclusions were drawn about the predominance of cognitive learning styles in the selected programs.

CHAPTER 4

RESULTS

In this chapter the results of administering the Kolb Learning Style Inventory to Diesel Technology and Practical Nursing students at three selected colleges of technology in Montana are presented and are analyzed in reference to the research questions. The information from the interviews with students and faculty was compiled to gain more qualitative information about the students' learning style preferences and their learning environments. All of the results were interpreted in context of the research questions and according to prior research. In this study the first research question was, "What are the preferred learning styles of students in the Diesel Technology and Practical Nursing programs in selected colleges of technology in Montana?" The second question was "Is there a difference in preferred learning styles of students in the two selected programs in the selected colleges of technology?" Orr et al.. (1999) found that students enrolled in vocational-technical programs related best to the "physical, hands-on world and think in ways that are methodical, ordered, and predictable" (p. 2). Also, research indicated that people tend to select learning and working groups with similar learning style preferences (Kolb 1984; Kolb, Boyatzis, & Mainemelis, 1999).

A third research question was added to this study as a result of analysis of data from the Learning Styles Inventory. The question was, "Do the students' learning style preferences vary with the instructional practices and expectations of the educational

programs?" Research has indicated that college education shapes students' learning styles (Armstrong, 1994;Kolb, Boyatzis, & Mainemelis, 1999). The results of this study were analyzed in reference to this research and the research question.

The results from the Kolb Learning Style Inventory were compared by the frequency of learning styles for the total student group and subgroups in the study. The frequencies were analyzed by percentages, while the Chi-Square Goodness of Fit and test of independence were used to test the probability of the differences between learning styles within groups and between comparable groups. Line charts show the visual comparison of the percentages of preferences of learning styles.

Learning Style Preferences of All Students

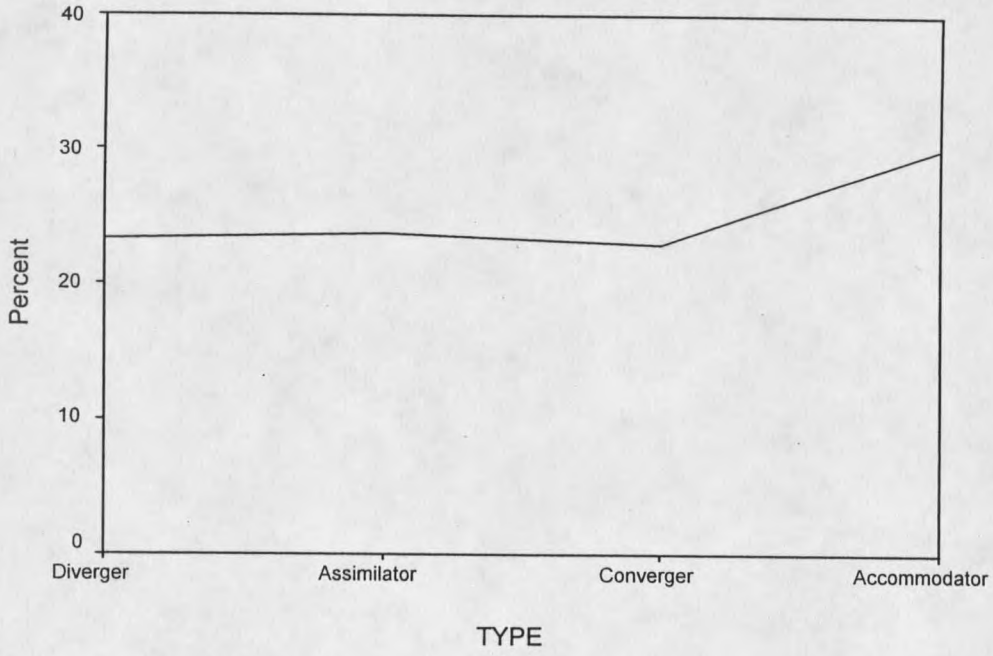
The first research question for this study was, "what were the preferred learning styles of students in the Diesel and Practical Nursing programs in selected colleges of technology in Montana?" As shown in Table 4, 56 of the 240 students in the study chose the Diverger Learning Style, 57 the Assimilator, 55 the Converger, and 72 the Accommodator. By percentage, the results were 23.3% for the Diverger, 23.8% for the Assimilator, 22.9% for the Converger, and 30.0% for the Accommodator learning style.

Table 4. Frequency and Percentages of Learning Style Preferences for All Students

Learning Style	N	% of Total N
Diverger	56	23.3%
Assimilator	57	23.8%
Converger	55	22.9%
Accommodator	72	30.0%
Total	240	100%

As illustrated in Figure 2, the students in the study as a total group in technical education did not show a statistically significant preference for any one learning style.

Figure 2. Learning Styles of All Students



A Chi-Square Goodness of Fit was conducted to determine the statistical significance of differences as shown in Table 5. The expected number was held even for each of the four categories. A null hypothesis of no difference in the preferred learning styles was expected. A p of 0.357 indicated that there was not a statistically significant difference in learning style preferences.

Table 5. Chi-Square of Learning Style Preference of All Students

Learning Style	Observed N	Expected N
Diverger	56	60.0
Assimilator	57	60.0
Converger	55	60.0
Accommodator	72	60.0
$X^2(3, N = 240) = 3.23, p = .357$		

These results indicated that there was not a statistically significant difference in the distribution of learning style preferences among the students in this study. They were a diverse group in learning styles and as a group did not show a dominant preference for any one learning style. These results did not support the research that generally categorized students in technical programs as preferring hands-on activities or working with the inanimate (Orr et al., 1990). The results of this study did not suggest that the students in this study collectively preferred one learning style to another.

Agreement with Inventory Results

As shown in Table 6, 167 or 70% of the 240 students agreed with the results of their personal learning style as described by the Kolb Learning Style Inventory. Twelve percent did not agree with the results, and 25% of the students did not respond to the question. One student agreed with the results some of the time–this student may have used different learning styles for different situations. When considering only the responders, 167 of 179 students or 93% of the responders agreed with the Inventory. These results indicated that the Learning Style Inventory was an instrument with which most of the students agreed with its results.

Table 6. Frequency of Students that Agreed or Disagreed with the Results of the Inventory Instrument

Response	Frequency	Percent
Yes	167	70%
No	12	5%
No Response	60	25%
Sometimes	1	0%

Learning Style Preferences by Program

The second question of this study asked if there was a difference among the students in the two selected programs. When the reported learning styles of Diesel Technology students were compared to the Practical Nursing students, a statistical significant difference was found in their pattern of preferences. As shown in Table 7, 12 of the 80 Diesel students chose the Diverger Learning Style, 17 preferred the Assimilator, 25 selected the Converger, and 26 had a preference for the Accommodator Style. The percentage of Diesel students choosing the Diverger style was 15.0%, Assimilator 21.3%, Converger 31.3% and Accommodator 32.5%. In contrast, of the 160 Nursing students, 44 chose the Diverger, 40 preferred the Assimilator, 30 selected the Converger, and 46 had a preference for the Accommodator Learning Style. By percentage, 27.5% of the Nursing students chose the Diverger Style, 25.0% preferred the Assimilator, 18.8% selected the Converger, and 28.8% had a preference for the Accommodator Learning Style. A Chi-Square test of independence of the two programs found a statistically significant difference at p of 0.051, $\alpha = .10$.

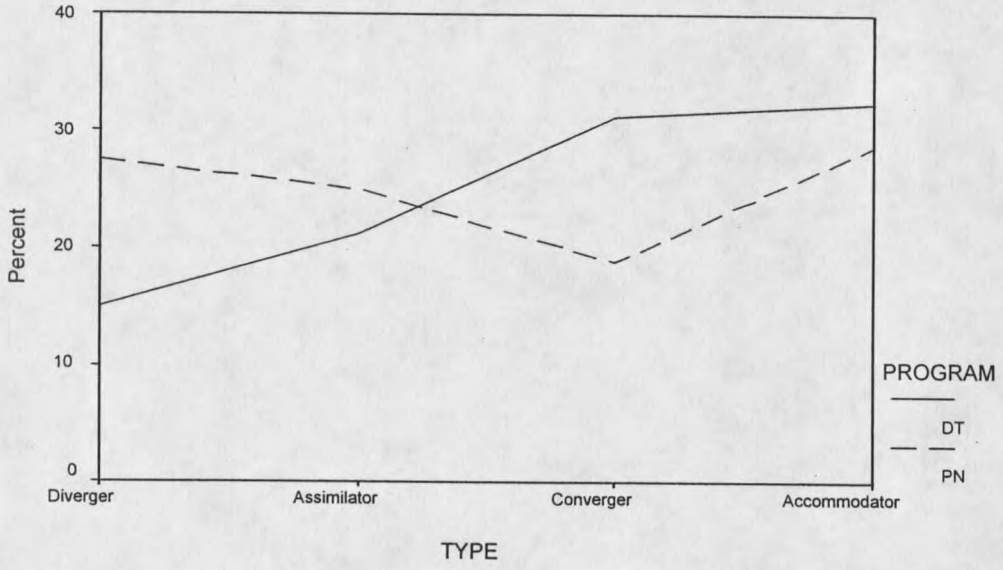
Table 7. Learning Style Preferences for All Students by Program

Program		Learning Style				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
DT	Observed	12	17	25	26	80
	Expected	18.7	19.0	18.3	24.0	80
	% within	15.0%	21.3%	31.3%	32.5%	100
PN	Observed	44	40	30	46	160
	Expected	37.3	38.0	36.7	48.0	160
	% within	27.5%	25.0%	18.8%	28.8%	100
Total	Observed	56	57	55	72	240
	Expected	56.0	57.0	55.0	72.0	240
	% within	23.3%	23.8%	22.9%	30.0%	100

$X^2(3, N = 240) = 7.77, p = .051$

The contrasting patterns of preferences for the Diesel Technology and the Practical Nursing students are shown in Figure 3. The Diesel students reflected a strong preference for the Converger and Accommodator Learning styles and a low preference for the Diverger Style. In contrast, the results of the Nursing students indicated a strong preference for the Diverger and Accommodator Styles and a low preference for the Converger Style.

Figure 3. Learning Style Preferences for All Students by Program



The results of this study pointed to a statistically significant difference of the distribution of students' learning style preferences in the Diesel and Nursing programs at a p of 0.051. The Diesel students' preference for the Converger and Accommodator Learning styles suggested a preference for trying out and practicing new information and skills with hands-on experiences. Nurses, however, with preferences for the Diverger and Accommodator styles had a preference for having a concrete experience (see Figure 1) with new information rather than abstract observation. Concrete experience and

abstract conceptualization are opposites on Kolb's continuum for grasping information. Having only 15% of the Diesel students choosing the Diverger style indicated a low preference for using imagination in the learning process. Having only 18.8% of Nursing students choosing the Converger style pointed to a low preference for learning from logical analysis or working with the inanimate. The results of this study demonstrated support of Kolb's research that learners select college programs in which students' predominant learning styles are similar to their own (1984). The results also supported the research that found differences of learning style preferences between genders (Diaz, 1986). This relationship will be discussed later in the chapter.

When comparing students within the programs, a Chi-Square test of independence indicated that a statistically significant difference of the distribution of learning style preferences did not exist for any one or more learning styles. In Table 8, a Chi-Square test of independence with the Diesel students resulted in a p of 0.156, which was not statistically significant at $\alpha = .10$.

Table 8. Learning Style Preferences for Diesel Students

	Learning Style				
Counts	Diverger	Assimilator	Converger	Accommodator	Total
Observed	12	17	25	26	80
Expected	18.7	19.0	18.3	24.0	80
% within	15.0%	21.3%	31.3%	32.5%	100
$X^2(3, N = 80) = 5.23, p = .156$					

In Table 9, a Chi-Square test of independence with the nursing students reflected a p of 0.718, which was not statistically significant at $\alpha = .10$.

Table 9. Learning Style Preferences for Nursing Students

Counts	Diverger	Assimilator	Converger	Accommodator	Total
Observed	44	40	30	46	160
Expected	37.3	38.0	36.7	48.0	160
% within	27.5%	25.0%	18.8%	28.8%	100
X^2 (3, N = 160) = 1.35, p = .718					

The Chi-Square test of independence, then, in Table 7 indicated a statistically significant difference between the patterns of learning style preferences of the Diesel and Nursing students. When comparing the results within the two programs in Tables 8 and 9, however, the results suggested that the students did not prefer any one or more learning styles at a statistically significant level.

Learning Style Preferences by Colleges

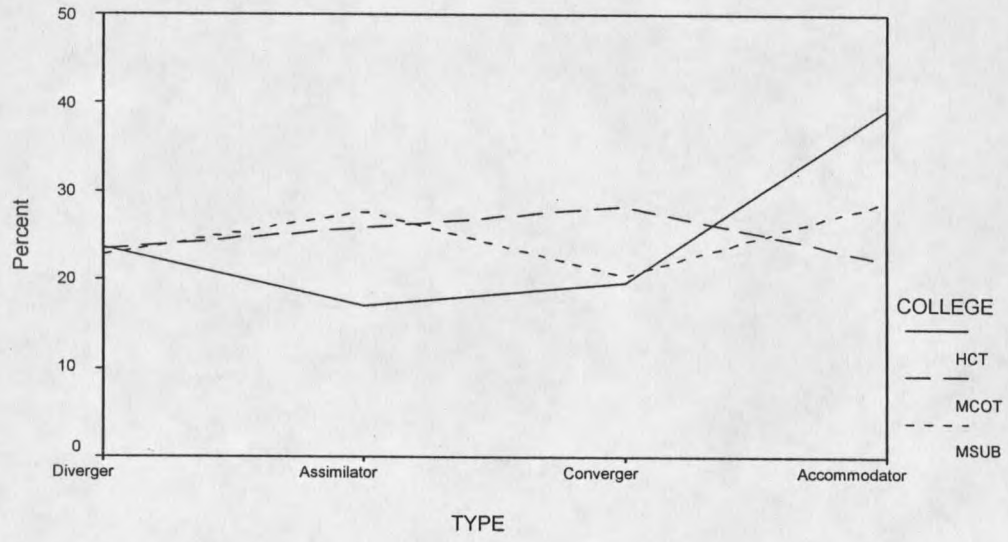
A comparison was made of the learning style preferences of the students by college. As shown in Table 10, a comparison of the colleges did not indicate a statistically significant difference of learning style preferences with 18 UM-H students choosing the Diverger Learning Style, 13 the Assimilator, 15 the Converger, and 30 the Accommodator Learning Style. In percentages those counts were 23.7%, 17.1%, 19.7%, and 39.5% for the respective learning styles. The MCOT and MSUB students' results were relatively even at 23.5%, 25.9%, 28.4%, and 22.2% for MCOT and 22.9%, 27.7%, 20.5%, and 28.9% for the MSUB students. The p on the Chi-Square test was 0.262 for a comparison across the three colleges.

Table 10. Comparison of All Students by College

College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
UM-H	Observed	18	13	15	30	76
	Expected	17.7	18.1	17.4	22.8	76
	% within	23.7%	17.1%	19.7%	39.5%	100
MCOT	Observed	19	21	23	18	81
	Expected	18.9	19.2	18.6	24.3	81
	% within	23.5%	25.9%	28.4%	22.2%	100
MSUB	Observed	19	23	17	24	83
	Expected	19.4	19.7	19.0	24.9	83
	% within	22.9%	27.7%	20.5%	28.9%	100%
Total	Observed	56	57	55	72	240
	Expected	56.0	57.0	55.0	72.0	240
	% within	23.3%	23.8%	22.9%	30.0%	100
$X^2(3, N = 240) = 7.68, p = .262$						

The pattern of the students' choices by college is shown in Figure 4. The UM-H students noticeably preferred the Accommodator Learning Style, but not at a statistically significant level across the colleges or within each of the colleges.

Figure 4. Learning Style Preferences for All Students by College



When comparing the learning style preferences of the students within each of the colleges, Chi-Square test of independence did not indicate a statistically significant difference of the distribution of learning style preferences. The results in Table 11 point to a p of 0.256 for the UM-H students.

Table 11. Learning Style Preferences of UM-H Students

College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
UM-H	Observed	18	13	15	30	76
	Expected	17.7	18.1	17.4	22.8	76
	% within	23.7%	17.1%	19.7%	39.5%	100
	$X^2(3, N = 76) = 4.05, p = .256$					

The results in Table 12 indicated a p of 0.416 for the MCOT students.

Table 12. Learning Style Preferences of MCOT Students

College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
MCOT	Observed	19	21	23	18	81
	Expected	18.9	19.2	18.6	24.3	81
	% within	23.5%	25.9%	28.4%	22.2%	100
	$X^2(3, N = 81) = 2.84, p = .416$					

The results in Table 13 reflected a p of 0.848 for the MSUB students.

Table 13. Learning Style Preferences of MSUB Students

College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
MSUB	Observed	19	23	17	24	83
	Expected	19.4	19.7	19.0	24.9	83
	% within	22.9%	27.7%	20.5%	28.9%	100%
	$X^2(3, N = 83) = 0.80, p = .848$					

Collectively, the students in this study did not have a preference for any one learning style at any of the three colleges. A statistically significant difference of learning style preferences did not exist when all of the students were compared by college.

Diesel Students by College

A comparison of Diesel students by college did not show a significant difference across the colleges. The results in Table 14 indicated that 10.7% of the UM-H Diesel students preferred the Diverger learning style, 14.3% chose the Assimilator, 39.3% selected the Converger, and 35.7% had a preference for the Accommodator. The preferences for MCOT Diesel student were 20% for the Diverger, 26.7% for the Assimilator, 26.7% for the Converger, and 26.7% for the Accommodator. The results for the MSUB students suggested preferences of 13.6% for the Diverger, 22.7% for the Assimilator, 27.3% for the Converger, and 36.4% for the Accommodator. A Chi-Square test of independence indicated that there was not a statistically significant difference of distribution of learning style preferences across the colleges in the Diesel programs at a p of 0.765.

Table 14. Learning Style Preferences of Diesel Students by College

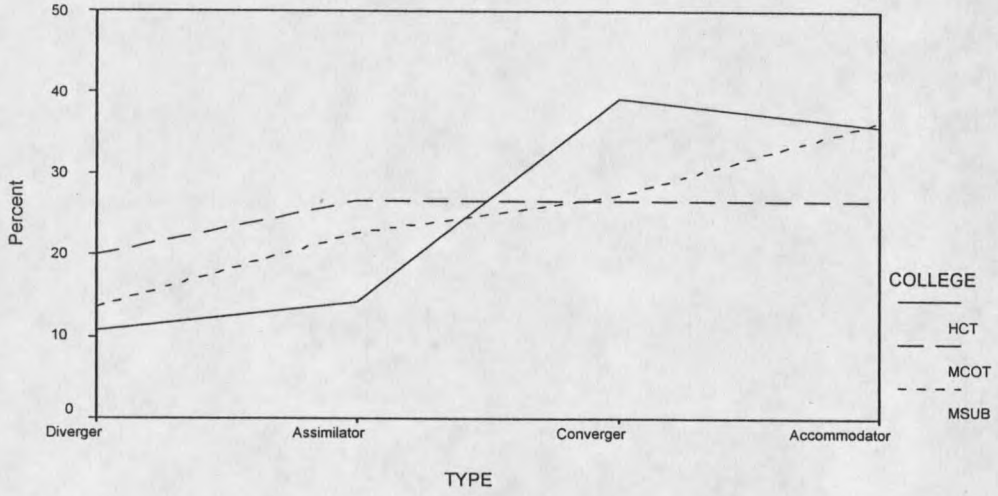
College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
UM-H	Observed	3	4	11	10	28
	Expected	4.2	5.9	8.8	9.1	28
	% within	10.7%	14.3%	39.3%	35.7%	100%
MCOT	Observed	6	8	8	8	30
	Expected	4.5	6.4	9.4	9.8	30
	% within	20.0%	26.7%	26.7%	26.7%	100%

MSUB	Observed	3	5	6	8	22
	Expected	3.3	4.7	6.9	7.2	22
	% within	13.6%	22.7%	27.3%	36.4%	100%
Total	Observed	12	17	25	26	80
	Expected	12.0	17.0	25.0	26.0	80
	% within	15.0%	21.3%	31.3%	32.5%	100%

$X^2(3, N = 80) = 3.34, p = .795$

The patterns of learning style preferences for the Diesel students by college are shown in Figure 5. There was a noticeable pattern of preference for the Accommodator Learning Style and a low preference for the Diverger Style. As shown in Tables 15,16, and 17, however, these preferences were not statistically significant.

Figure 5. Comparison of Learning Style Preferences of Diesel Students by College



The Diesel students from each of the colleges did not reflect a statistically significant difference within each group on Chi-Square tests of independence. The results of the analysis for UM-H Diesel students are shown in Table 14 indicating a p of 0.661.

Table 15. Learning Style Preferences for UM-H Diesel Students

College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
UM-H	Observed	3	4	11	10	28
	Expected	4.2	5.9	8.8	9.1	28
	% within	10.7%	14.3%	39.3%	35.7%	100%
		$X^2(3, N = 28) = 1.59, p = .661$				

The analysis in Table 16 resulted in a p of 0.695 for the MCOT Diesel students.

Table 16. Learning Style Preferences for MCOT Diesel Students

College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
MCOT	Observed	6	8	8	8	30
	Expected	4.5	6.4	9.4	9.8	30
	% within	20.0%	26.7%	26.7%	26.7%	100%
		$X^2(3, N = 30) = 1.44, p = .695$				

The analysis in Table 17 suggested a p of 0.969 for the MSUB Diesel students.

Table 17. Learning Style Preferences for MSUB Diesel Students

College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
MSUB	Observed	3	5	6	8	22
	Expected	3.3	4.7	6.9	7.2	22
	% within	13.6%	22.7%	27.3%	36.4%	100%
		$X^2(3, N = 22) = 0.25, p = .969$				

The results of the learning style preferences of Diesel students were fairly consistent across the colleges with some deviation by the UM-H students. A statistically significant difference did not exist, however, in the results across the colleges or within the colleges. The results suggested that the Diesel students did not choose colleges by preference of learning styles. Other factors, such as college location and recruitment initiatives, may be more important in the students' selection of Diesel programs.

Practical Nursing Students by College

The previous analysis of the students' results indicated no significant difference in the learning style preferences across all the colleges for all students and for the Diesel students. However, the analysis of the Nursing students' results across the colleges suggested a statistically significant difference of students' learning style preferences. The results in Table 18 reflect that the UM-H Nursing students preferred the Diverger and Accommodator Learning styles with 31.3%, 18.3%, 8.3%, and 41.7% for the four respective styles. The results for the MCOT and MSUB Nursing students suggest relatively even preferences with percentages of 25.5, 25.5, 29.4, and 19.6 for MCOT and 26.2, 29.5, 18.0, and 26.2 for MSUB for the Diverger, Assimilator, Converger, and Accommodator learning styles. A Chi-Square test of independence across the colleges in the Nursing programs pointed to a statistically significant difference with a p of 0.064 at α of 0.10.

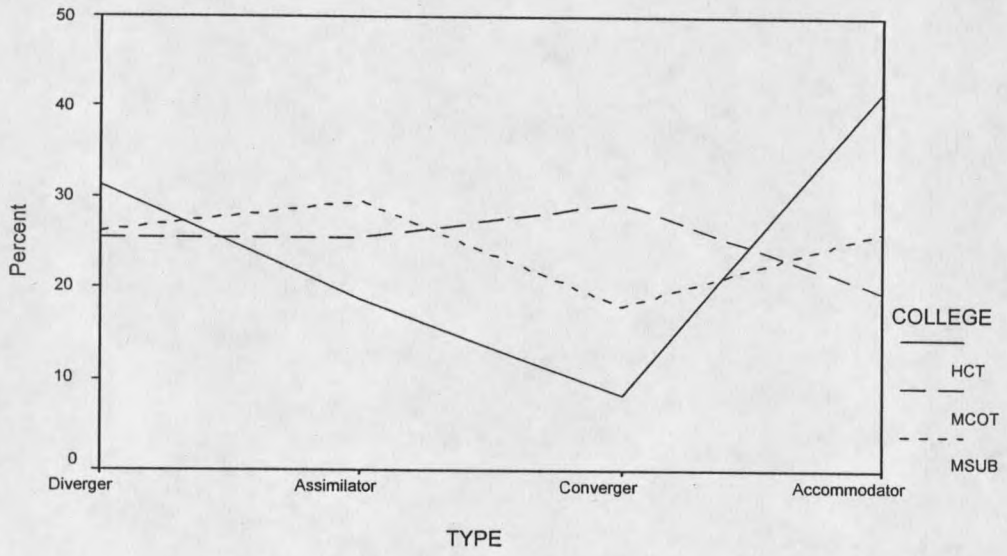
Table 18. Comparison of Learning Style Preferences of Practical Nursing Students by College

College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
UM-H	Observed	15	9	4	20	48
	Expected	13.2	12.0	9.0	13.8	48.0
	% within	31.3%	18.8%	8.3%	41.7%	100.0%
MCOT	Observed	13	13	15	10	51
	Expected	14.0	12.8	9.6	14.7	51.0
	% within	25.5%	25.5%	29.4%	19.6%	100.0%
MSUB	Observed	16	18	11	16	61
	Expected	16.8	15.3	11.4	17.5	61.0
	% within	26.2%	29.5%	18.0%	26.2%	100.0%
Total	Observed	44	40	30	46	160
	Expected	44.0	40.0	30.0	46.0	160.0
	% within	27.5%	25.0%	18.8%	28.8%	100.0%

$X^2(3, N = 160) = 11.90, p = .064$

The pattern of preferences for the Nursing students by college is shown in Figure 6. A contrasting pattern of preferences by the UM-H Nursing students indicated their preference for the Diverger and Accommodator Learning Style and a low preference for the Converger Learning Style.

Figure 6. Comparison of Learning Style Preferences of Practical Nursing Students by College



When comparing Nursing students within colleges for preferences in learning styles, the UM-H students pointed to a statistically significant difference on a Chi-Square test at a p of 0.087, $\alpha = .10$ in Table 19.

Table 19. Learning Style Preferences of UM-H Nursing Students

College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
UM-H	Observed	15	9	4	20	48
	Expected	13.2	12.0	9.0	13.8	48.0
	% within	31.3%	18.8%	8.3%	41.7%	100.0%
$X^2(3, N = 48) = 6056, p = .087$						

Furthermore, the results in Table 20 do not indicate a statistically significant difference in learning style preferences for the MCOT Nursing students at a p of 0.202 on a Chi-Square test of independence.

Table 20. Learning Style Preferences of MCOT Nursing Students

College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
MCOT	Observed	13	13	15	10	51
	Expected	14.0	12.8	9.6	14.7	51.0
	% within	25.5%	25.5%	29.4%	19.6%	100.0%
$X^2(3, N = 51) = 4.62, p = .202$						

In Table 21, an analysis of the MSUB Nursing students suggest a p of 0.883 on a Chi-Square test, which was not statistically significant at α of 0.10.

Table 21. Learning Style Preferences of MSUB Nursing Students

College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
MSUB	Observed	16	18	11	16	61
	Expected	16.8	15.3	11.4	17.5	61.0
	% within	26.2%	29.5%	18.0%	26.2%	100.0%
$X^2(3, N = 61) = 0.657, p = .883$						

As a group, the UM-H Nursing students' preferences were statistically significantly different from the MCOT and MSUB Nursing students in their Learning Style Inventory preferences. They indicate a preference for the Diverger and Accommodator Learning Styles and a low preference for the Converger Style. The MCOT and MSUB students did not reflect a preference for any learning style. The UM-H Nursing students' results were similar to the overall Nursing student pattern of preferences as shown in Figure 3. They suggested a preference for experiencing new knowledge concretely over learning from abstract means and a preference for trying out

and practicing new knowledge and skills over reflecting. These results raise the question of what influenced the learning style preferences of the UM-H Practical Nursing students. Did these students choose UM-H for their program based on philosophy and teaching styles of the faculty? Or, have the students adapted their learning style based on the UM-H Nursing program learning environment? Kolb found that current learning tasks influenced learning styles (Kolb, Boyatzis, & Mainemelis, 1999). The classroom instructors, assignments and testing may have influenced the UM-H Nursing students' choices of preferred learning styles. The UM-H Nursing Program Chair, was not sure why her students would prefer the Diverger and Accommodator Learning Styles so strongly and in contrast to the other Nursing students. She noted that the faculty members in the UM-H Nursing program were very interactive with their students, used a significant amount of visual, hands-on instruction, and spent more time in lab and clinical experiences than in lecture.

Learning Style Preferences by Year in College

A comparison did not find a statistical difference among the students in this study by their year in college. As shown in Table 22, the first-year students' preferences were relatively even with 35 of the 141 students preferring the Diverger Learning Style, 36 the Assimilator, 34 the Converger, and 36 the Accommodator Style. By percentage, the preferences were 24.8% for the Diverger Style, 25.5% for the Assimilator, 24.1% for the Converger, and 25.5% for the Accommodator. The second-year students indicated a preference for the Accommodator Learning Style with 21 of them showing a preference for each of the Diverger, Assimilator and Converger Styles and 36 having a preference

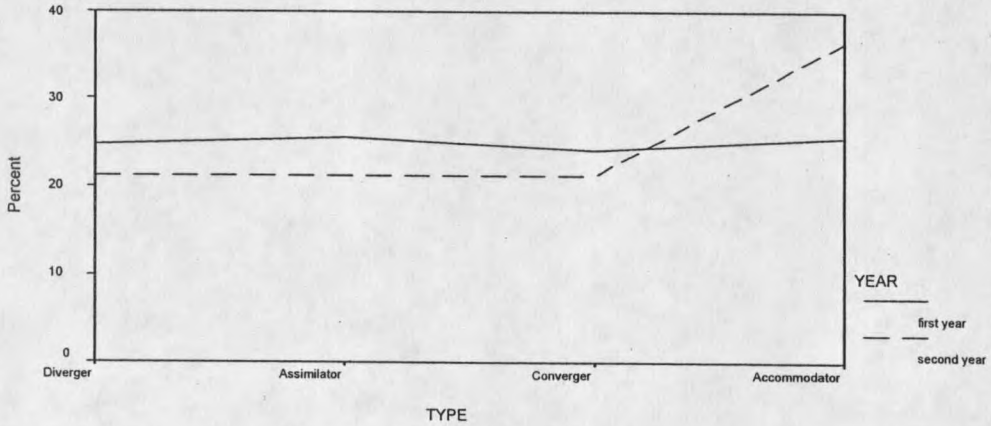
for the Accommodator. In percentages those counts were 21.2% for the first three styles and 36.4% for the Accommodator Learning Style. A Chi-Square test of the differences between the years in college did not reflect a difference in preferences at $p = 0.352$.

Table 22. Comparison of Learning Style Preferences for All Students by Year in College

Year in College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
First	Observed	35	36	34	36	141
Year	Expected	32.9	33.5	32.3	42.3	141
	% within	24.8%	25.5%	24.1%	25.5%	100%
Second	Observed	21	21	21	36	99
Year	Expected	23.1	23.5	22.7	29.7	99
	% within	21.2%	21.2%	21.2%	36.4%	100%
Total	Observed	56	57	55	72	240
	Expected	56.0	57.0	55.0	72.0	240
	% within	23.3%	23.8%	22.9%	30.0%	100%
$X^2(3, N = 240) = 3.27, p = .352$						

The patterns of preferences for the students in this study when compared by their year in college are shown in Figure 7. The results suggested that the first-year students' preferences were relatively equal, but the second-year students had some preference for the Accommodator Learning Style. Statistically, however, significant differences did not exist between the two years in college or among the groups.

Figure 7. Comparison of Learning Style Preferences for All Students by Year in College



When testing for significance among the first-year students, a Chi-Square test did not suggest a preference for any one learning style at p of 0.718. The results of the Chi-Square analysis of first year students are found in Table 23.

Table 23. Learning Style Preferences for First-Year Students

Year in College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
First	Observed	35	36	34	36	141
Year	Expected	32.9	33.5	32.3	42.3	141
	% within	24.8%	25.5%	24.1%	25.5%	100%
		$X^2(3, N = 141) = 1.35, p = .718$				

Although Figure 7 reflects a pattern of preference by the second-year students for the Accommodator Learning Style, it was not statistically significant as shown in Table 24. A Chi-Square test indicated that the second-year students did not have a preference with a p of 0.589.

Table 24. Learning Style Preferences of Second-Year Students

Year in College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
Second	Observed	21	21	21	36	99
Year	Expected	23.1	23.5	22.7	29.7	99
	% within	21.2%	21.2%	21.2%	36.4%	100%
		$X^2(3, N = 99) = 1.92, p = .589$				

In this study, no statistically significant difference existed between the first and second year students in learning style preferences, nor was there a preference for any learning style within the groups. Students did not indicate that success in reaching the second year of college was due to a learning style preference. A screening out of learning styles by faculty or a self-selection by the students by learning styles was not

suggested in the results of this study. These results did not support Nulty and Barret's (1986) research that students select learning styles more related to their discipline in the final stages of their education.

First-Year Students by Program

A comparison of first-year students by program did not reflect a statistically significant difference in learning style preference at a $p = .192$ on a Chi-Square test of independence as shown in Table 25. The Diesel students' results were 15.4%, 20.5%, 30.8%, and 33.3% while the Nursing students were 28.4% 27.5%, 21.6%, and 22.5% on the Diverger, Assimilator, Converger, and Accommodator learning styles respectively.

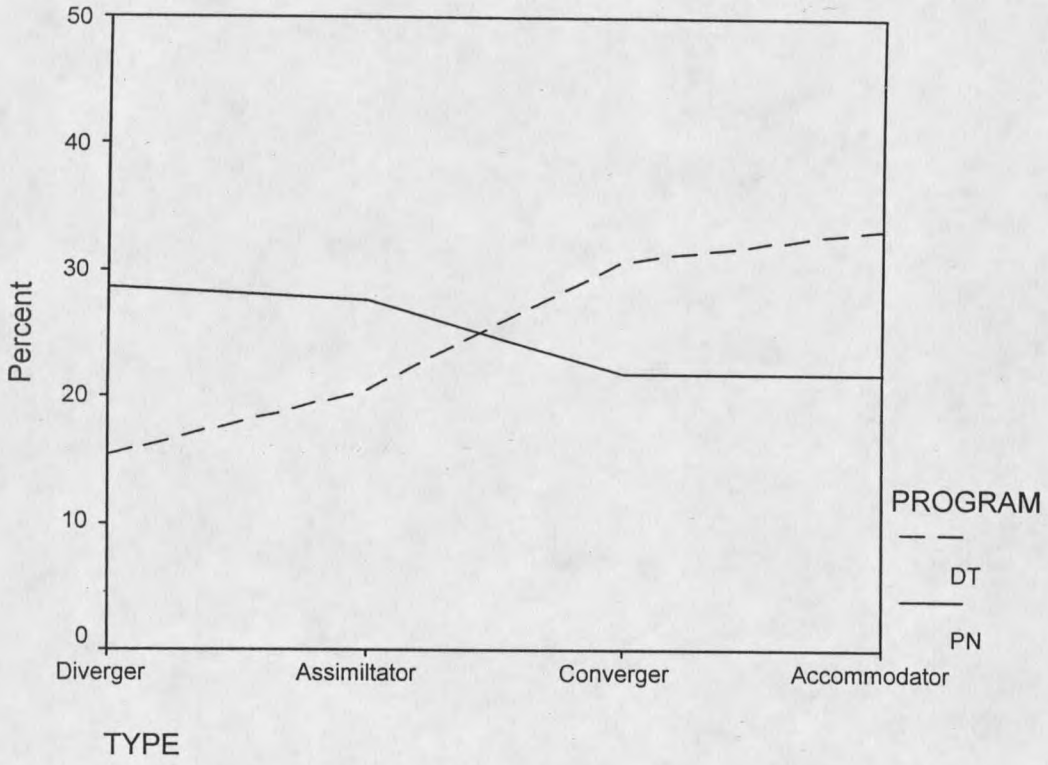
Table 25. Comparison of Learning Style Preferences of First-Year Students by Program

Program		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
DT	Observed	6	8	12	13	39
	Expected	9.7	10.0	9.4	10.0	39
	% within	15.4%	20.5%	30.8%	33.3%	100%
PN	Observed	29	28	22	23	102
	Expected	25.3	26.0	24.6	26.0	102
	% within	28.4%	27.5%	21.6%	22.5%	100%
Total	Observed	35	36	34	36	141
	Expected	35.0	36.0	34.0	36.0	141
	% within	24.8%	25.5%	24.1%	25.5%	100%

$X^2(3, N = 141) = 4.74, p = .192$

The patterns of preferences for the first-year students in this study when compared by their program are shown in Figure 8. The results indicate that the Diesel students had a preference for the Converger and Accommodator learning styles while the first-year Nursing students had a preference for the Diverger and Assimilator learning styles.

Figure 8. Comparison of Learning Style Preferences of First-Year Students by Program



The first-year Diesel students as a group did not have a statistical preference for any one learning style on a Chi-Square test at a p of 0.310. Table 26 shows the results of the analysis of the first-year Diesel students.

Table 26. Learning Style Preferences of First-Year Diesel Students

Program		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
DT	Observed	6	8	12	13	39
	Expected	9.7	10.0	9.4	10.0	39
	% within	15.4%	20.5%	30.8%	33.3%	100%
$X^2(3, N = 39) = 3.59, p = .310$						

Also, a statistically significant difference did not exist among learning style preferences for first-year Practical Nursing students with p of 0.767 on a Chi-Square analysis as shown in Table 27.

Table 27. Learning Style Preferences of First-Year Nursing Students

Program		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
PN	Observed	29	28	22	23	102
	Expected	25.3	26.0	24.6	26.0	102
	% within	28.4%	27.5%	21.6%	22.5%	100%
	$X^2(3, N = 102) = 1.14, p = .767$					

The first-year students did not indicate a difference in preferences between programs and did not have a preference for learning styles in either the Diesel or Nursing programs. The results in this comparison of first-year students did not suggest that the Diesel or Nursing students selected their educational program on the basis of learning style. Notably, however, when both years are combined as in Table 7, a significant difference was observed between the two programs.

Second-Year Students by Program

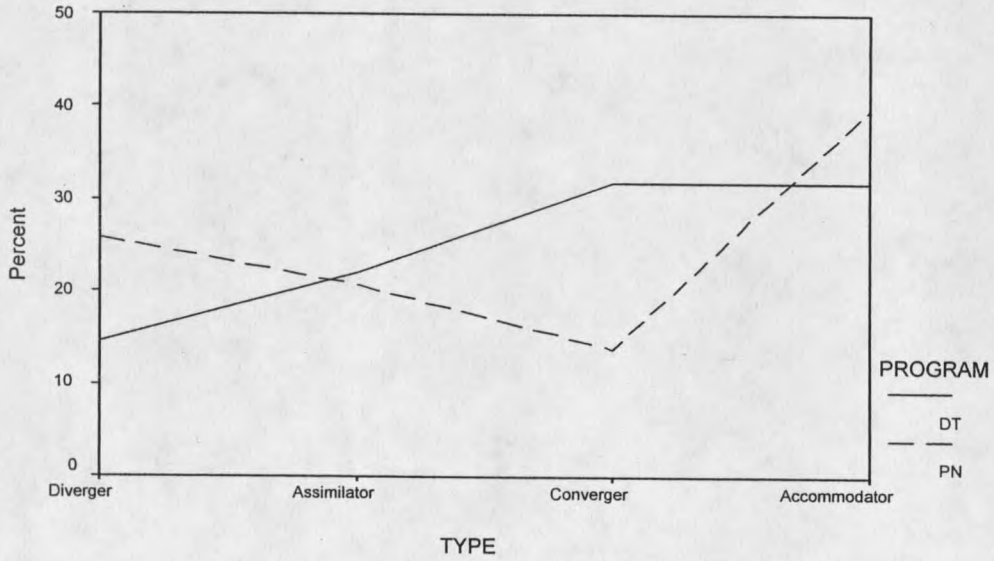
As shown in Table 28, a comparison of second-year students by program did not point to a statistically significant difference of distribution of learning style preferences. The Diesel students' results were 14.6%, 22.0%, 31.7%, and 31.7% and the Nursing students' results were 25.0%, 20.7%, 13.8%, and 39.7% for the respective learning styles. The Chi-Square test of independence resulted in a p of 0.139.

Table 28. Comparison of Learning Style Preferences of Second-Year Students by Program

Programs		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
DT	Observed	6	9	13	13	41
	Expected	8.7	8.7	8.7	14.9	41
	% within	14.6%	22.0%	31.7%	31.7%	100%
	Expected	12.3	12.3	12.3	21.1	58
	% within	25.9%	20.7%	13.8%	39.7%	100%
Total	Observed	21	21	21	36	99
	Expected	21.0	21.0	21.0	36.0	99
	% within	21.2%	21.2%	21.2%	36.4%	100%
$X^2(3, N = 99) = 5.50, p = .139$						

The patterns of learning style preferences for second-year Diesel and Nursing students are shown in Figure 9. The patterns are similar to those of all students by program as shown in Figure 3. The second-year Nursing students had a strong preference for the Accommodator Learning Style; however, the differences were not statistically significant.

Figure 9. Comparison of Learning Style Preferences of Second-Year Students by Program



The second-year Diesel and Nursing students did not show a statistically significant preference for any learning style. The results of a Chi-Square analysis for the second-year Diesel students in Table 29 indicated a p of 0.360.

Table 29. Learning Style Preferences of Second-Year Diesel Students.

Programs		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
DT	Observed	6	9	13	13	41
	Expected	8.7	8.7	8.7	14.9	41
	% within	14.6%	22.0%	31.7%	31.7%	100%
$X^2(3, N = 41) = 3.22, p = .360$						

The results of a Chi-Square test of independence for the second-year Nursing students in Table 30 had a p of 0.517.

Table 30. Learning Style Preferences of Second-Year Nursing Students.

Programs		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
PN	Observed	15	12	8	23	58
	Expected	12.3	12.3	12.3	21.1	58
	% within	25.9%	20.7%	13.8%	39.7%	100%
$X^2(3, N = 58) = 2.27, p = .517$						

This comparison of programs by year in college suggested that previous statistically significant differences in learning style preferences by program were not influenced by year in college. The difference between the learning style preferences of Diesel students when compared to Nursing students probably was not influenced by the students' years in college.

Diesel Students by Year in College

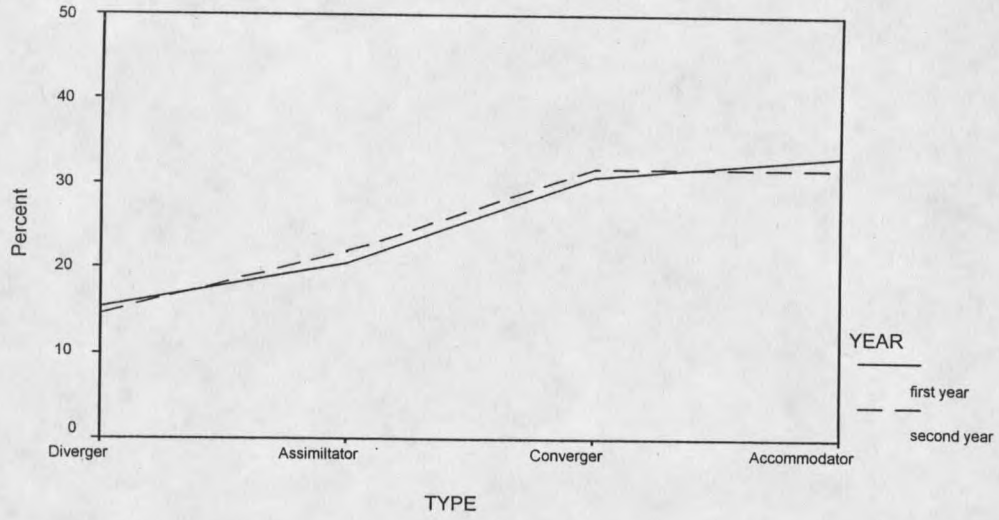
As shown in Table 31, a comparison of Diesel students from all the colleges between first year and second year reflect a nearly identical pattern of preferences. The first-year Diesel students had percentages of 15.4%, 20.5%, 30.8%, and 33.3% preference for the respective learning styles and second year had 14.6%, 22.0%, 31.7%, and 31.7%. The Chi-Square analysis resulted in a p of 0.997 for differences between years.

Table 31. Comparison of Learning Style Preferences for Diesel Students by Year in College

		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
First Year	Observed	6	8	12	13	39
	Expected	5.9	8.3	12.2	12.7	39
	% within	15.4%	20.5%	30.8%	33.3%	100%
Second	Observed	6	9	13	13	41
Year	Expected	6.1	8.7	12.8	13.3	41
	% within	14.6%	22.0%	31.7%	31.7%	100%
Total	Observed	12	17	25	26	80
	Expected	12.0	17.0	25.0	26.0	80
	% within	15.0%	21.3%	31.3%	32.5%	100%
$X^2(3, N = 80) = 0.05, p = .997$						

The nearly identical pattern of learning style preferences of first- and second-year Diesel students is shown in Figure 10.

Figure 10. Comparison of Learning Style Preferences of Diesel Students by Year in College



The results for the first- and second-year Diesel students indicate nearly the same preferences for learning styles. These results suggest that very little screening or self-selection of Diesel students by learning style preferences between the first and second year in college occurred.

Practical Nursing Students by Year in College

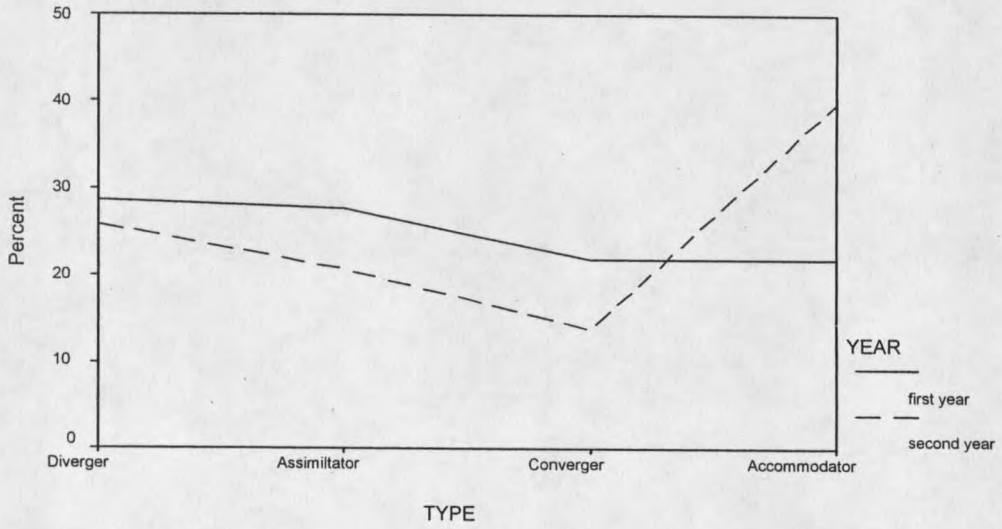
Table 32 shows a comparison of Practical Nursing students by year. Percentages of choices were 28.4%, 27.5%, 21.6% and 22.5% for the first year for the respective learning styles and 25.9%, 20.7%, 13.8%, and 39.7% for the second year. A Chi-Square analysis did not denote a difference of preferences with a p of 0.126.

Table 32. Comparison of Learning Style Preferences of Nursing Students by Year in College

Year in College		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
First Year	Observed	29	28	22	23	102
	Expected	28.1	25.5	19.1	29.3	102
	% within	28.4%	27.5%	21.6%	22.5%	100%
Second Year	Observed	15	12	8	23	58
	Expected	16.0	14.5	10.9	16.7	58
	% within	25.9%	20.7%	13.8%	39.7%	100%
Total	Observed	44	40	30	46	160
	Expected	44.0	40.0	30.0	46.0	160
	% within	27.5%	25.0%	18.8%	28.8%	100%
$X^2(3, N = 102) = 5.72, p = .126$						

Figure 11 shows a dissimilar pattern of learning style preferences between first- and second-year Nurses. The pattern for the first-year Nurses indicates a relatively equal preference across the four learning styles. In contrast, the pattern for the second-year nurses suggests a preference for the Accommodator Learning Style. The differences in these patterns of preferences, however, were not statistically significant.

Figure 11. Comparison of Learning Style Preferences of Nursing Students by Year in College



The lack of statistical difference between the first- and second-year Nurses indicated that there may not have been any screening or self-selection from the first year to the second year by learning style preferences. The course work in the Nursing programs does not appear to have been tailored to any one or more learning styles.

Learning Style Preferences by Gender

The Learning Styles were compared by gender as shown in Table 33. The results indicated a statistically significant difference between females and males. The percentages of female students' learning style preferences were 28.2% for the Diverger Learning Style, 24.8% for the Assimilator, 19.5% for the Converger, and 27.5% for the Accommodator. The male students' choices were 15.4% for the Diverger Learning Style, 22.0% for the Assimilator, 28.8% for the Converger, and 27.3% for the Accommodator. A Chi-Square test independence between the genders suggested a statistical difference at p of 0.071, $\alpha = 10$.

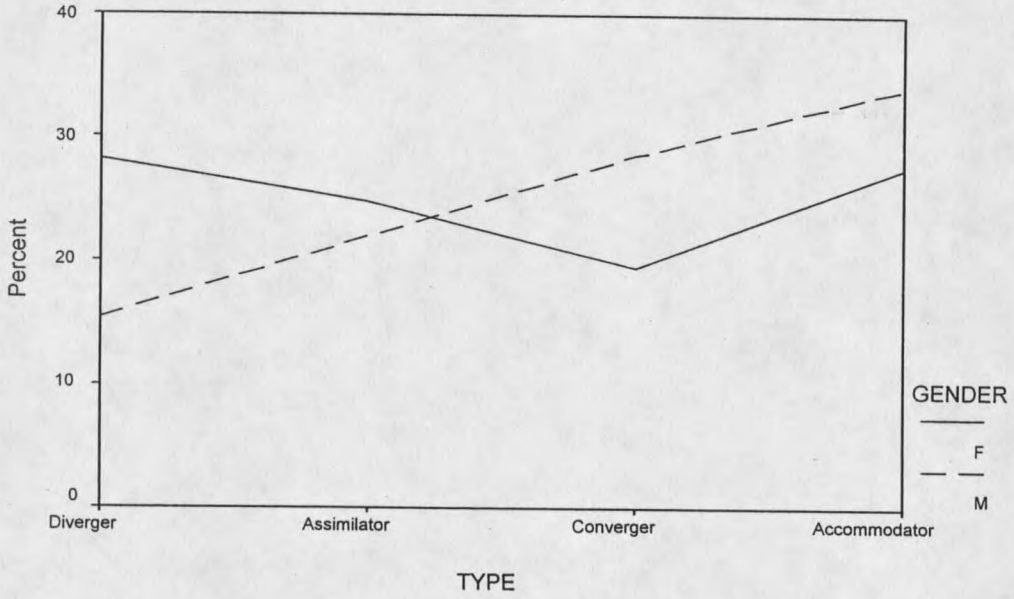
Table 33. Comparison of Learning Style Preferences by Gender

Gender		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
Female	Observed	42	37	29	41	149
	Expected	34.8	35.4	34.1	44.7	149
	% within	28.2%	24.8%	19.5%	27.5%	100%
Male	Observed	14	20	26	31	91
	Expected	21.2	21.6	20.9	27.3	91
	% within	15.4%	22.0%	28.6%	34.1%	100%
Total	Observed	56	57	55	72	240
	Expected	56.0	57.0	55.0	72.0	240
	% within	23.3%	23.8%	22.9%	30.0%	100%

$X^2(3, N = 240) = 7.02, p = .071$

Figure 12 shows the patterns of the learning style preferences between genders. They are similar to the patterns reflected in Figure 3 when comparing the learning style preferences by program. The pattern of the male students is similar to the pattern of the Diesel program that is predominantly male. The pattern of the female students is similar to the Nursing program that is predominantly female.

Figure 12. Comparison of Learning Style Preferences by Gender



As was noted in the comparison between the programs, a statistically significant difference occurred between the patterns of learning style preferences of the genders at a p of 0.071. There was not, however, a preferred learning style within either gender group. As shown in Table 34, a Chi-Square test of independence did not indicate a statistically significant preference for one or more learning styles by the Males with a p of 0.230.

Table 34. Learning Style Preferences of Male Students

Gender		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
Male	Observed	14	20	26	31	91
	Expected	21.2	21.6	20.9	27.3	91
	% within	15.4%	22.0%	28.6%	34.1%	100%
	$X^2(3, N = 91) = 4.31, p = .230$					

The results of a Chi-Square analysis of the Female preferences indicated no statistically significant preference for any one or more learning styles at a p of 0.452 as shown in Table 35.

Table 35. Learning Style Preferences of Female Students

Gender		TYPE				
	Counts	Diverger	Assimilator	Converger	Accommodator	Total
Female	Observed	42	37	29	41	149
	Expected	34.8	35.4	34.1	44.7	149
	% within	28.2%	24.8%	19.5%	27.5%	100%
	$X^2(3, N = 149) = 2.63, p = .452$					

Some research suggested that females tend to prefer the Diverger Learning Style and males prefer the Converger Style (Diaz, 1986; NASSP, 1979). Although the results of this study pointed to a statistical difference between genders, there were no statistically significant preferences within either gender. With the Nursing program as primarily female and the Diesel program as primarily male, gender preferences may have influenced students' selection of programs. The patterns of gender learning style preferences were similar to the respective programs in this study.

Student Interviews

The administration of the Kolb Learning Style Inventory was followed by interviews of ten students and six lead program instructors. The results of the student interviews are described in this section beginning with a question and ending with a compilation of the students' comments.

1. What is your preferred learning style according to the Kolb Learning Style Inventory?

As noted in Table 36 of the ten students interviewed, two were Divergers, four were Assimilators, three Convergers, and one was an Accommodator. The students for the interviews were selected as by convenience sample. They were students who were able to arrange their schedules and were willing to meet for a follow-up interview to the LSI.

Table 36. Characteristics of Students Interviewed

L. Style	Prog.	Agreed	No Change	Confirmed	Changed
Diverger	PN	N			X
Diverger	DT	Y	X		
Assimilator	PN	Y	X		
Assimilator	PN	Y		X	
Assimilator	DT	N		X	
Assimilator	DT	N			X
Converger	DT	Y		X	
Converger	DT	Y	X		
Converger	DT	Y	X		
Accommodator	PN	N			X

2. Did you find that knowing your learning style affected your ability to learn in class?

As noted in Table 36, six of the ten students reported that learning their learning style helped them to be better students by confirming or changing their approach to learning. For most students the results of the Learning Style Inventory (LSI) were the students' first understanding their learning style. They perceived that knowing their learning styles either confirmed or improved their learning strategies. Three of those six changed their approach to learning as a result of the LSI results. They were from three different learning styles: Diverger, Assimilator, and Accommodator. The Assimilator student said, "I stopped trying to learn everything right away, and take the material with me and study it later. I also take the lecture material into the shop and try it out on the equipment until I understand it." None of the three who changed their approach to learning agreed with findings on their personal inventory. The remaining three students gained more confidence in their learning approach by confirming awareness about their learning style. Two of those were Assimilators, and one was a Converger. One of these three students, the Assimilator, did not initially agree with the findings of the Inventory for himself. Four of the ten students reported that the Learning Style Inventory information did not make a difference in the way that they approached learning. Each of these four students agreed with their preference given by the Inventory. There was one Diverger, one Assimilator, and two Convergers. Three of the four who did not change their approach to learning were in the Diesel Technology Program. Notably, the three Convergers in the interviews agreed with the personal inventory findings and did not change their approach to learning. Knowing the learning style from Kolb's LSI appeared

to help six of the interviewees to either modify their study habits or gain more confidence in the style of studying.

3. Describe in greater detail how you learn classroom material the best. How does that relate to the learning styles described by Dr. Kolb?

Table 37. How Students Described Their Learning Styles In-Depth

L. Style (LSI)	Prog.	Diverger	Assimilator	Converger	Accommodator
			(as described)		
Diverger	PN		X		
Diverger	DT	X			
Assimilator	PN		X		
Assimilator	PN		X		
Assimilator	DT		X		
Assimilator	DT		X		
Converger	DT			X	
Converger	DT			X	
Converger	DT			X	
Accommodator	PN	X			

In Table 37, eight of the ten students interviewed reported that they learned classroom material similarly to the Kolb Learning Style Inventory (LSI). More specifically, two of the students liked to talk to other students about new information as Divergers are described by Kolb (Kolb, Boyatzis, & Mainemelis, 1999). By the LSI, one was a Diverger but the other was an Accommodator who stated that she liked sharing ideas with classmates and getting feedback. Five of the students liked to study using approaches similar to the Assimilator Learning Style. They liked to receive the information and take time to process it. Additionally, they studied the new information, thought about it, and worked on their own to process it. Four of those were Assimilators, and one was a Diverger by the LSI. The Diverger student did not agree with her findings

on the inventory and stated that she did not like group work. She liked getting the material and spending time on her own thinking about it. This approach to learning is more similar to Kolb's description of the Assimilator Learning Style (Kolb, Boyatzis, & Mainemelis, 1999). Three of the students described their learning habits as being similar to the Converger Learning Style. They preferred to take new information to the lab and apply it. All of them were Convergers by the LSI. None of the students interviewed described approaches to learning similar to an Accommodator. They did not want to try new situations without having had a lecture or reading material. Most of the students interviewed described their learning preferences in ways that indicated agreement with the findings of the LSI for each of them.

4. Do you change the way you learn according to different situations?

Nine of the students suggested that they did not change learning styles in different learning situations. They tended to focus more intently when in less comfortable learning situations by using the approaches and activities that worked well for them. For instance, one of the students who was most comfortable with hands-on experience, read and quizzed himself more thoroughly in lecture classes and made it as much a hands-on experience as he could. One of the Assimilators found that she had to let go of control in group settings and let other students make decisions. She learned to allow equal participation and to propose questions as a way of working within the group process. Only one student indicated a substantially different learning approach in different situations. He found abstract learning much more difficult than hands-on. In abstract learning situations, he seemed to change from a preferred Diverger style of learning to one similar to a Converger. He would try out different concepts to see if they were right.

He said, "Sometimes when material is not explained very well, you have to try things and see if you have it right." These student responses did not support Kolb's finding that students adopted new learning styles in different learning environments (Kolb, 1984). Most of these students seemed to focus more on what learning strategies that worked best for them than changing their learning style.

5. Do you find that some students' learning styles are more successful in studying than others? If so, how are they more successful?

When asked if some students' learning styles helped them to be more successful in learning than others, there was a mixed response. Three of the interviewees felt that motivation and organization determined success more than learning styles. One student observed, "Some students do not know how to start or organize their studying." Four other students judged that some students were quicker at picking up new information and some have better recall abilities. Two of the students indicated that learning styles might have an influence. They found that some students were more successful in some learning situations than others. Six of the students felt that a teacher's skill in explaining information made a difference. The use of different teaching methods and the instructor's making an effort to connect with students were suggested as significant in a student's ability to learn new concepts.

The students in these interviews suggested that it was helpful to know more about themselves and their preferred learning style. They either changed their approach to learning or gained confidence in their approach. Although they may have disagreed initially with the LSI results, the description of their learning approaches several weeks later were similar to people in the LSI learning style. Even in different learning

environments, whether lecture or lab, most of the students did not change their style, but focused more on those approaches that worked best for them. The students observed that usually factors other than learning styles influenced success in learning. They stated that motivation, organization, ability to recall, and teaching skills made the most significant difference in a student's success.

These comments from student interviews indicated that both knowledge of one's personal learning style and being motivated to succeed were perceived as beneficial to the improvement of study strategies and success of the students. Furthermore, the students perceived that it was not the teaching style, but the willingness of the teacher to help the students understand new concepts that was most helpful in learning new information. These findings reinforced the research of Felder and Andrews (1989). Felder's (1996) research at the university level found that teachers must teach to the full spectrum of learning styles. Andrew's (1989) studies in vocational education found that awareness of learning styles by both the teacher and students helped students become more adaptive learners.

Faculty Interviews

The Department Chair or lead faculty member from each college program was interviewed following the completion of learning styles inventory. Four of the six faculty members interviewed were Department Chairs or Program Directors. Two were lead faculty members in the program, one of which was the only full-time faculty member in that program. The comments to each interview question are summarized below.

1. What is the philosophy of your department?

When describing department philosophy, the nursing program faculty tended to focus more on student learning, whereas the Diesel faculty focused more on preparing the student for the workplace. The only full-time instructor in the Diesel Program at MSUB stated, "The student must learn that they are [sic] usually working for 'the man' or a boss and that they must satisfy him." Within colleges, the MCOT faculty in both Nursing and Diesel focused more on lifelong learning than specific work place skills. Neither the faculty at MSUB nor UM-H indicated a commonality between the Nursing and Diesel programs. Among Nursing programs, the UM-H faculty emphasized student responsibility in the learning partnership, the MSUB faculty started instruction at the level of the students' conceptual understanding, and the MCOT faculty focused on lifelong learning. The Nursing faculty focused more on student learning while the Diesel faculty focused more on job readiness.

2. What is an acceptable rate of completion for your program?

The faculty members for both program areas expressed a goal for a rate of completion of 90 to 100%, but were unwilling to lower their standards of student preparation to meet those high rate of completion goals.

3. What is the completion rate of students in the program?

The Nursing programs reported completion rates of 35% at MSUB, 72% at MCOT, and 65% at UM-H with an average of 57%. The Diesel faculty reported completion rates of 100% at MSUB, 50% at MCOT, and 70% at UM-H with an average of 73%.

4. Why do students drop out of your program?

Most of the faculty members indicated that students dropped out of their programs more for personal reasons than for academic reasons. Personal crises with spouses, children, or illness seemed to be the overriding causes of dropping out. However, the Nursing faculty from both the MCOT and MSUB programs observed substantial dropout due to academic reasons. The Department Chair of the MSUB Nursing Program, stated that the stress of the program was a significant factor in student dropout, especially during the clinical instruction. She stated that their "clinical instructors are very structured and have almost no tolerance for not following the rules of the course." Clinical instruction is the portion of the curriculum described as training experiences in medical health facilities where students conduct nursing care for patients (MSU-B catalog, 2002).

Other reasons the faculty suggested for students dropping out of the programs were career compatibility, lack of attendance, and lack of motivation to succeed. The Diesel faculty also indicated that the inability to read often caused students to fail academically in the Diesel programs. Low reading skills of some Diesel students prevented the students from understanding the course textbooks and equipment repair manuals.

5. Do you see a difference between the first-year and second-year students in the way that they learn?

When observing differences in the way first-year and second-year students learn, generally the faculty reported that second-year students were more mature in the use of their learning strategies. Second-year students were more focused and more independent

of their faculty and they exhibited better critical thinking skills. The Department Chair of the UM-H Trades and Industry Department and instructor in the Diesel Program, stated that the second-year students were "more focused and spend more time and effort at learning the content material. They do more homework and realize the value of the related courses in General Education."

6. What is the average tenure of your faculty with the program?

The average faculty tenure in the current assignment was seven years for the MSUB Nursing Program with a range from three to 11, two years for UM-H Nursing program with a range two to three years, eight years for the MCOT Nursing program with a range of one to 22 years, 24 years in the MSUB Diesel program, 18 years for the UM-H Diesel program with a range of 12 to 23 years, and 13 years for the MCOT Diesel program with a range of 12 to 14 years.

7. How do your teachers teach? Do they use a variety of teaching methods? Is there a systematic attempt to connect with the students?

The Diesel faculty members reported using interactive lectures extensively in the classroom. They stimulated student participation through questioning and thought-provoking concepts, and used visuals of overheads, PowerPoint, and demonstrations. The Nursing Directors indicated that the Nursing faculty lectured much of the time, but varied in the amount of their connectivity to the students. Many Nursing faculty members used a variety of modes to promote student understanding, but some simply delivered the information and left it to the students to use their own resources to master understanding. The answers to this question by the Nursing faculty indicated that the UM-H Nursing faculty preferred a more interactive style than those at MSUB or MCOT.

The Program Chair of the UM-H Nursing Program, stated that the department "tries to systematically connect with the students."

8. What are your class sizes for lecture and lab?

Most lecture class sizes in all six programs ranged from ten to 30 students. In the MSUB Nursing program, the beginning courses ran from 27 to 30 students and were mostly lecture. The second-year classes enrolled 15 to 16 with ten in the clinical sections. In the UM-H Nursing program, the lecture classes were from 33 to 20. The labs were about 15, and clinical was limited to eight students. The MCOT nursing classes were usually limited to 20 students, but students also took related classes like Anatomy and Physiology that could accommodate as many as 75 students. The math and English classes enrolled from 20 to 25.

In the MSUB Diesel program, the lecture/lab classes enrolled up to 27. Sixteen was optimal. The UM-H Diesel program had lecture/lab classes at nine to 20 students with one class that started with 34 students. The MCOT Diesel program had about 25 to 30 in the first semester and about 20 in the second year.

9. What is the lecture to lab ratio?

The lecture/lab ratio varied from 70% lecture and 30% lab for the MSUB and MCOT Nursing programs to 40% lecture and 60% lab in the UM-H Nursing program. The MSUB Diesel faculty member did not define his ratio, but reported a lot of discussion in the classroom and lab. The UM-H Diesel program reported a ratio of 30% lecture and 70% lab, and the MCOT Diesel program reported a 50/50 ratio.

10. How do you know that students are ready for graduation?

The criteria for judging whether or not a student was ready for graduation was essentially readiness for the job. Although mastery of course content was important, Nursing faculty made observations of a student's readiness to handle multiple patients at one time and to think critically on the floor to judge job readiness. Diesel faculty gauged a student's readiness for an employer's probationary period of employment. Organization, workmanship, and confidence were criteria that Diesel faculty members used to judge student readiness. The lead instructor of the Diesel Program at MCOT noted that "when a student is on time to class, ready to work, and is organized he is ready for the job." To him "the organization of a student's toolbox is an indication of the student's workmanship and organizational skills."

11. How do you know when a student is having trouble in the program? What steps do you take?

Faculty members found that symptoms of emotional stress, drops in grades, problems with basic skills, changes in attitude or attendance, and lack of understanding were symptoms of students having trouble with the program. The Department Chair of the MCOT Nursing Program, stated that "Poor test performance is a first indicator. Generally, I wait until the second test. If I see a problem, I refer them to the retention counselor who has an early warning system that is very effective." The MSUB Diesel instructor spent more time with the students in trouble trying to improve basic skills and understanding, but all of the faculty members reported referring students to learning centers and counselors when they could not help the student.

Summary of Findings from Faculty Interviews

In review of the information from the faculty interviews, differences were noted between the instructional practices and expectations of the Nursing and Diesel programs. In the program philosophy statements, the Nursing programs stressed the importance of student learning, whereas the Diesel programs focused on student preparation for the workplace. The completion rates of the Nursing programs were generally lower with an average of 57% while the Diesel programs support a 73% average. When asked about teaching styles, the Nursing and Diesel faculty reported extensive use of lecturing with a difference in their connectivity to the students. The Diesel faculty commonly used an interactive style, dialoguing with the students throughout the lecture period. In contrast, the Nursing faculty reported a variety of lecture styles. Some used a range of techniques to enhance student learning as understanding required; other faculty presented the lecture material without much dialogue with the students. The lecture/lab ratio of the programs was described as generally more lecture than lab by the Nursing faculty as a group and less lecture than lab by the Diesel faculty. And finally, when responding to the question of measuring student readiness to graduate, the Nursing faculty assessed the student's ability to manage multiple patient care, and the Diesel faculty evaluated the student's ability to succeed in the probationary period of employment.

Differences were also noted between the instructional practices and expectations of the Nursing programs at the different colleges. Philosophically, the UM-H program emphasized student responsibility in the learning partnership, the MSUB program focused on starting instruction at the level of the student's conceptual understanding, and the MCOT program centered on lifelong learning. When reporting the reasons for

student withdrawal from the educational programs, the faculty stated that students dropped out more for personal reasons than for academic reasons. This was not the case for the MSUB and MCOT programs, where academic issues were cited more often as reasons for dropping out. The stress of the clinical program at MSUB was particularly noted as significant in the reasons for dropping out of the Billings program.

Other differences noted between the three Nursing programs were in faculty tenure within their programs, class sizes, and lecture/lab ratio. The average tenure of MSUB and MCOT faculty in their programs was seven and eight years while the UM-H faculty reported an average of two years. Most reported lecture class sizes that ranged from 15 to 33 students while the clinical courses were limited to ten or less students. The MCOT program conducted some courses in Anatomy and Physiology of up to 75 students. When reporting on lecture/lab ratios, the UM-H program differed from the MSUB and MCOT programs by having less lecture time reported than lab time.

Some observations of the program faculty were common across all six of the programs in this study. As faculty members observed students advancing to the second year of college, they noted that it seemed to be student motivation and maturity in the learning process that changed. Faculty did not observe a change in student learning style preferences, nor did they notice a predominant learning style that was more successful than others in determining student success. The conclusions from the student and faculty interviews are consistent with Biggs' (1978) research that found that educational purpose and abilities are more important in students' success than learning style preferences.

Summary of Results

The results of this study indicated that the students in the Diesel and Practical Nursing programs at the three selected colleges of technology in Montana were diverse in the preference of learning styles. The literature review for this study indicated that the learning styles of students in technical or occupational programs preferred the Convergent Learning Style (learning about the inanimate) to other learning styles; however, no one learning style was statistically dominant in this study.

Although no learning style was predominant among the students in either the Diesel Technology or Practical Nursing programs, a statistical difference occurred in the patterns of learning style preferences between the programs. The Diesel students had a strong preference for the Converger and Accommodator Learning Style, while the Practical Nursing students had a preference for the Diverger and Accommodator Learning Style and a low response to the Converger.

Some of the differences may be attributable to a gender pattern of learning style preferences since the two programs selected for this study were gender dominant. As noted in Tables 1 and 2, there was one female in the 85 Diesel students and ten males in the 157 Practical Nursing students in this study. Some research (Diaz, 1986) indicated that females tend to not prefer the inanimate or Converger Learning Style, but prefer the social aspect or the Diverger style of learning. Males tended to reject the social learning environment and preferred to learn about the inanimate. The patterns of learning style preferences observed in this study were similar to the preferences identified in earlier research.

Analyses of other subgroups in this study did not find statistical differences between the groups. No difference occurred between the students in the different colleges overall, nor was there a difference between the first and second-year students. One exception was a statistically significant difference between colleges when comparing the Nursing programs. The UM-H Nursing program students showed a significant preference for the Diverger and Accommodator Learning Style and a low preference for the Converger.

Chapter Summary

The research questions asked these questions: "What are the preferred learning styles of students in the Diesel Technology and Practical Nursing programs in selected colleges of technology in Montana," and is there a difference between in students preferred learning styles in the two selected programs in the selected colleges of technology. The results in this study indicated that student learning-style preferences occurred equally across the four learning styles from the Kolb Learning Style Inventory. No single or combined learning styles were dominant even when compared by college.

The results of this study suggested that, overall, a diverse student population existed in the Diesel Technology and Practical Nursing programs at the three selected Montana colleges of technology in terms of learning style preferences. Three statistically significant patterns of learning style preferences occurred in the student results. The pattern of preferences between the Diesel and Nursing students were significant, and the preferences of the UM-H Nursing students were statistically different from Nursing students in the other two colleges. The third pattern of preferences occurred between

male and female preferences. The only statistically significant preference for one or more learning styles indicated was within the UM-H Nursing program. These students preferred the Diverger and Accommodator Learning Styles to the Assimilator and Converger Learning Styles.

The student and faculty interviews indicated that, while knowing the learning style was helpful, the particular style itself had little influence on classroom success or ability to move to the second year of the program. Success was determined more by motivation and dedication to the program as reflected by both students and faculty.

CHAPTER 5

CONCLUSIONS

Introduction

This study addressed the problem of a dearth of knowledge about the learning styles of students in specific two-year college programs. Research indicated that instructors could be more effective in designing teaching methods and materials that promote success and competency in the classroom if they knew more about their students' learning styles (Andrews, 1989).

In this study the learning styles of students in the Diesel Technology and Practical Nursing programs in three selected colleges of technology in Montana were inventoried and analyzed using the Kolb Learning Style Inventory, which separated learning styles into four categories of Diverger, Assimilator, Converger, and Accommodator. Divergent learners like brainstorming and using their imagination, Assimilators prefer to build theoretical models by thinking things through, Convergers favor working with the inanimate, and Accommodators have a preference for exploring and trying out new knowledge and skills using a trial-and-error approach (Kolb, Boyatzis, & Mainemelis, 1999).

Frequency comparisons and Chi-Square Goodness of Fit and tests of independence were conducted to analyze the learning style preferences for all students and several subgroups. Comparisons of learning style preferences were made by

program, college, programs within colleges, year in college, year within programs, and gender. Also, students and faculty were interviewed as a follow up to the inventory to better understand the students' learning style preferences and the relationships of students' learning style preferences to instructional practices of the programs.

Collectively, the students in this study did not prefer any single or combined learning styles to another. A statistically significant preference did not occur in the distribution of Kolb's four learning styles in this study's results. By program, however, a statistically significant difference transpired in the patterns of learning style preferences between the Diesel Technology and Practical Nursing students. The Diesel students indicated a preference for the Converger and Accommodator Learning Styles, while the Nursing students had a preference for the Diverger and Accommodator Learning Styles. There was no statistical significance of learning style preferences between the students in the different colleges, except when comparing the Nursing students among the three colleges. In contrast to the other two colleges, the results from the UM-H Nursing students pointed to a preference for the Diverger and Accommodator Learning Style with a low preference for the Converger Learning Style.

Statistical analyses of other subgroups in this study did not reveal significant differences, except in the comparison of gender learning style preferences. Female students indicated a statistically significant difference in learning style preferences from the male students. The female students were primarily Nurses and preferred the Diverger and Accommodator learning styles. Male students in contrast were primarily Diesel students and preferred the Converger and Accommodator learning styles.

In an analysis of the interviews with the students, it was found that students' knowledge of their personal learning style preferences either helped them change their approach to learning or gave them more confidence in their learning strategies. When reflecting on success factors for their peers, the students felt that even though some students had a superior ability to grasp and retain new knowledge, an individual's motivation to succeed in the program was the key factor. Once again, students did not think that learning style preference was a significant factor in success in the classroom.

The analysis of the faculty interviews found that a relationship was apparent between the students' learning style preferences and the instructional practices and expectations of the educational programs. Differences between the Nursing and Diesel programs were reflected in both the statistical data and the information reported in the faculty interviews. The Nursing students indicated a preference for the Diverger and Accommodator learning styles, while the Diesel students reflected a preference for the Converger and Accommodator learning styles. In the faculty interviews, Nursing faculty focused on student learning, but the program had a lower completion rate and more lecture than lab time. The Diesel faculty philosophically centered on student readiness for employment, and the program had a higher completion rate, more interaction in lectures, and more lab time than lecture in their programs. Further study is needed to see if there is a significant correlation between learning styles and instructional practices. Do such characteristics as program philosophy or the lecture/lab ratio shape learning styles?

Differences also existed between the three Nursing programs in both the statistical data and the information from the faculty interviews. The UM-H Nursing

students indicated a significant preference for the Diverger and Accommodator learning styles while the MCOT and MSUB Nursing students did not point to a preference for any one learning style over another. In the faculty interviews, the UM-H faculty member described some characteristics of the UM-H program that varied from the MSUB and MCOT Nursing program. The UM-H program emphasized student responsibility in learning. It had fewer dropouts for academic reasons, lower faculty tenure in the program, smaller class sizes, and less lecture than lab time. The Diverger and Accommodator learning styles each indicate a preference for Concrete Experience (see Figure 1) when grasping knowledge. Do the instructional practices of the Helena Nursing faculty cause students to prefer learning concretely meaning by the senses (touch, hearing, seeing, smell) (Kolb, 1984)?

Faculty members, as well as the students, noted a difference in the way teachers connected with students. Generally, some instructors believed that it was the students' responsibility to master understanding, not the instructors' responsibility to present material in different ways to assist understanding. Instructors who connected with students tended to use a variety of teaching methods or had a high level of interaction with students during instruction.

Conclusions from the Study

The research questions for this study were as follows:

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 preferred learning styles of students between the two selected programs in the selected colleges of technology?
3. Do the students' learning style preferences vary with the instructional practices and expectations of the educational programs?

These four conclusions were made from this study:

1. In response to the first research question, the students in this study, as a group in technical education, were not solely hands-on learners who preferred working with the inanimate.

The students in this study did not reflect a preference for any single or combination of learning styles. This result does not support the research that finds career students are hands-on learners who prefer working with the inanimate (Diaz, 1986;Kolb, Boyatzis, & Mainemelis, 1999; Orr et al., 1999). These students preferred the four learning styles at comparable frequencies. This implied that instructors for the students in this study taught to a variety of preferred learning styles in their classrooms. The study also suggested that the instructors designed their curriculum to accommodate a variety of learning styles giving ample time for students to experience both lecture and lab types of instruction.

The lack of a predominant learning style of the students in this study suggested an acceptance of diversity in learning styles by these programs. Screening by compatibility to an occupation's dominant style of learning is minimal in these programs.

2. In response to the second research question, is there a difference in the preferred learning styles of students between the two selected programs, learning style preferences of the students in this study varied by program.

A statistically significant difference occurred between the patterns of preference for the Diesel Technology programs in contrast to the Practical Nursing programs. The Diesel students indicated a pattern of preference for the Converger and Accommodator Learning Styles, while the Nursing students preferred the Diverger and Accommodator learning styles. These differences indicated that students' learning style preferences varied by educational program. This is consistent with Kolb's research suggesting that learners tend to select occupations in which colleagues have similar learning styles or adopt the predominant learning style of the people in the occupation (1984).

These results also point to support for the research of Diaz in 1986, concluding that learning style preferences differed by gender. Males in that research had a preference for the inanimate, and females demonstrated a preference for social context (Diaz, 1986; NASSP, 1979). With the two selected programs being single-gender dominant, a pattern of similarity to the research existed. The Diesel students were predominantly male and had a pattern of preference for the inanimate or Converger Learning Style, and the Nursing students were predominantly female and reflected a pattern of preference for social context or the Diverger Learning Style. The dominance of these preferences, however, were not statistically significant within each of the programs.

A uniqueness of the student preferences in this study is the strength of preference for the Accommodator Learning Style in both programs. Accommodators prefer "doing" in the learning process. They are action-oriented and like to use trial and error in new circumstances. This preference indicated a confidence in mastering understanding by trying it on their own. This strength of preference for the Accommodator appeared in the

Diesel students, the Helena students in both programs and in the second-year students in all programs. The only program, however, that had a statistical difference at α of .10 was the Nursing program in Helena. The results of the Helena Nursing students pointed to a significant preference for both the Diverger and Accommodator Learning Styles.

3. In answer to the third research question, a relationship may have existed between the students' learning style preferences and the instructional practices and expectations of the programs.

Two statistically significant differences were noted in the Learning Styles Inventory data between program groups. The pattern of learning style preferences among the Nursing students differed significantly from those of the Diesel students and the preferences of the UM-H Nursing students differed significantly from the Nursing students of the MSUB and MCOT Nursing programs. Likewise, the information from the faculty interviews indicated notable differences in the instructional practices and expectations between the Nursing and Diesel programs and between the colleges' three Nursing programs. The research literature suggested that college education shapes students' learning style preferences (Conti & Welborn, 1986; Kolb, 1984).

With the Diesel students' preferences for the Converger and Accommodator learning styles, an inclination for Active Experimentation (see Figure 1) is suggested. The UM-H Nursing students' preferences for the Diverger and Accommodator learning styles indicated an interest in Concrete Experience. By conducting interactive lectures and spending more time in lab than lecture, the Diesel and the UM-H Nursing program faculty members appeared to promote learning by experimentation and tangible

experience. Further study could focus more on the potential correlation between students' learning style preferences and instructional practices.

4. A fourth conclusion was drawn from this study that students in the three colleges of technology found it helpful to learn more about their learning styles.

Students reported that they either changed their approaches to learning or gained greater confidence in their current learning styles. Just the knowledge of learning styles often had an impact on their adoption of more successful study habits. In 1999, Robotham suggested that proficient learners had the ability to select learning strategies according to the learning environment and "their own learning capacity" (p. 6). The better a student understands their learning style preference, the more successful they can become as a learner (Biggs, 1978).

Program Implications

The results of this study were informative about students in two programs at the three colleges of technology. The students in these two programs had a variety of learning styles, which required instructor attention to a variety of teaching methods and classroom materials. The learning styles of Diesel students were different than those of Nursing students, but within the programs, no one learning style was dominant. These students were not solely hands-on learners as suggested by previous research. Technical colleges may be enrolling students with a wide variety of learning styles in their technical programs.

The results suggested that learning styles of the students in this study were related to instructional practices and expectations of the program. While the results of the LSI

for either the Nursing students on the Diesel students were not statistically significant, the Nurses grasped knowledge concretely and the Diesel student suggested a preference for trying out new knowledge on their own. The research results imply that the instructors in these programs could improve students' ability to learn by recognizing the diversity of learning styles in their classrooms and the general pattern of learning styles typically found in students entering these programs. More specifically, the instructors might emphasize lab experiences and demonstrations in presentations.

The results from the faculty and student interviews as well as from the comparison of the first and second years in college do not suggest that learning styles had an influence on students' ability to complete the first year and continue in the second year. A statistically significant difference did not occur between the first and second year. Also, students and faculty observed that students' ability to manage their personal lives and their motivation to succeed were dominant factors in student success. These results suggest that college retention programs connecting students to college life may have a greater impact on student retention than adapting teaching styles to student learning styles.

Knowledge of learning style preferences made a difference to the students' development of their study habits. In the student interviews, students suggested that they could use the information from the Learning Style Inventory to modify their approaches to studying or confirm and strengthen the use of current study habits. The student interviews reflected that students would often benefit by early knowledge of their learning style preferences in helping them to adapt and strengthen study strategies that work best for them. If these results hold true then, colleges could improve retention by

having students do an inventory of their learning styles early in their college programs and by giving students information about the learning styles that would help them strengthen their approaches to learning.

Recommendations for Further Study

A primary mission of two-year colleges is to increase access of students to higher education (Eller, Martinez, Pace, Pavel, Garza, & Barnett, 1998). The modern workplace depends extensively on a technically trained workforce that requires formal training and education beyond the secondary level (Eller et al., 1998). Increased knowledge about students increases the ability to connect with the students and provide them with a meaningful and beneficial educational experience. Because the study of students' learning styles and the factors of student success could benefit students' education opportunities, more study is needed to confirm or expand on these results. Specific recommendations for further study are the following:

1. The inventory of learning styles of vocational students needs to be expanded to include students in other technical programs and colleges.

An expanded study would enhance the generalizability of the results to students in vocational programs in all colleges of technology. This would point to similarities and differences of students in the different vocational programs and the differences between student-gender preferences. It may clarify the lack of differences between the students' first and second year in college. This would assist instructors by indicating whether or not they should focus more on one learning style in their classrooms or a diverse population of learning styles.

2. Cohorts of students should be studied during their time in college to observe change in learning styles as they adapt to educational programs and mature in the learning processes.

A study of cohorts through the college experience from entrance to graduation would give a better indication of how students adapt to the learning environments. If students maintained their learning style preference or adapted to different preferences, the instructors could assist the students in strengthening study habits.

3. Further studies should focus on the relationship between students' learning style preferences and the instructional practices and expectations of the educational programs. The researcher should evaluate the potential correlation between the students' learning style preferences and their choice of programs, or the impact of the college program on learning style preferences.
4. More focused studies of the impact of the knowledge of learning style preferences of students on student learning may be beneficial to the students and faculty.

If improvement in learning is a result of the students and faculty knowing about the students' learning style preferences, then colleges may assist students by instituting routine learning style inventories at student entry into their educational programs. The knowledge of learning style preferences may be a key factor in colleges becoming more learner centered.

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APPENDICES

APPENDIX A

LEARNING-STYLE INVENTORY

MCB200C

LEARNING-STYLE INVENTORY

The Learning-Style Inventory describes the way you learn and how you deal with ideas and day-to-day situations in your life. Below are 12 sentences with a choice of endings. Rank the endings for each sentence according to how well ou think each one fits with how you would go about learning something. Try to recall some recent situations where you had to learn something new, perhaps in your job or at school. Then, using the spaces provided, rank a "4" for the sentence ending that describes how you learn *best*, down to a "1" for the sentence ending that seems least like the way you learn. Be sure to rank all the endings for each sentence unit. Please do not make ties.

Example of completed sentence set:

1. When I learn: 2 I am happy. 1 I am fast. 3 I am logical. 4 I am careful.

Remember: 4 = *most* like you 3 = *second most* like you 2 = *third most* like you 1 = *least* like you

	A		B		C		D	
1. When I learn:	___	I like to deal with my feelings.	___	I like to think about ideas.	___	I like to be doing things.	___	I like to watch and listen.
2. I learn best when:	___	I listen and watch carefully.	___	I rely on logical thinking.	___	I trust my hunches and feelings.	___	I work hard to get things done.
3. When I am learning:	___	I tend to reason things out.	___	I am responsible about things.	___	I am quiet and reserved.	___	I have strong feelings and reactions.
4. I learn by:	___	feeling.	___	doing.	___	watching.	___	thinking.
5. When I learn:	___	I am open to new experiences.	___	I look at all sides of issues.	___	I like to analyze things, break them down into their parts.	___	I like to try things out.
6. When I am learning:	___	I am an observing person.	___	I am an active person.	___	I am an intuitive person.	___	I am a logical person.
7. I learn best from:	___	observation.	___	personal relationships.	___	rational theories.	___	a chance to try out and practice.
8. When I learn:	___	I like to see results from my work.	___	I like ideas and theories.	___	I take my time before acting.	___	I feel personally involved in things.
9. I learn best when:	___	I rely on my observations.	___	I rely on my feelings.	___	I can try things out for myself.	___	I rely on my ideas.
10. When I am learning:	___	I am a reserved person.	___	I am an accepting person.	___	I am a responsible person.	___	I am a rational person.
11. When I learn:	___	I get involved.	___	I like to observe.	___	I evaluate things.	___	I like to be active.
12. I learn best when:	___	I analyze ideas.	___	I am receptive and open-minded.	___	I am careful.	___	I am practical.

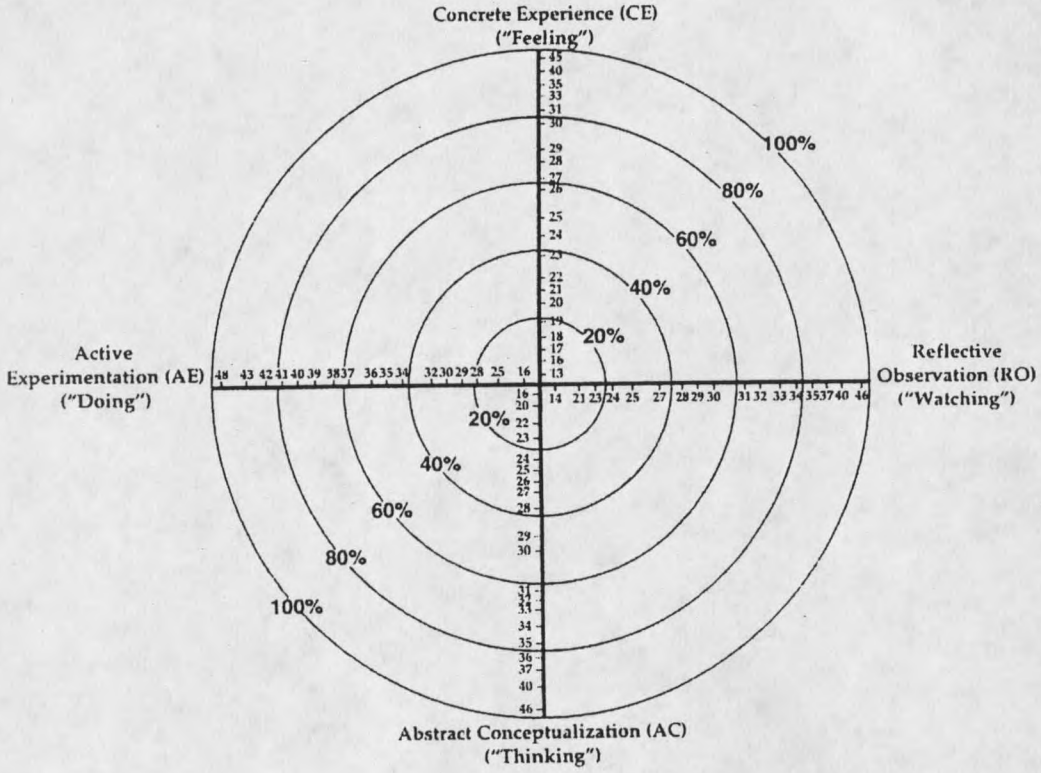
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APPENDIX B

THE CYCLE OF LEARNING

MCB200D

THE CYCLE OF LEARNING



_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_	= ☐
1A	2C	3D	4A	5A	6C	7B	8D	9B	10B	11A	12B	CE Total
_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_	= ☐
1D	2A	3C	4C	5B	6A	7A	8C	9A	10A	11B	12C	RO Total
_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_	= ☐
1B	2B	3A	4D	5C	6D	7C	8B	9D	10D	11C	12A	AC Total
_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_ +	_	= ☐
1C	2D	3B	4B	5D	6B	7D	8A	9C	10C	11D	12D	AE Total

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APPENDIX C

PERSONAL INFORMATION

Personal Information

Please complete the following information. This information will only be used to compile aggregate reports and will not refer to any one individual. It will be kept in strict confidence and destroyed after the data has been analyzed and verified.

Name _____

Program _____ Yr. _____

Gender _____ Age _____

Scores: AE – RO = ___ - ____ = _____

AC – CE = ___ - ____ = _____

Learner Type as shown by the results: (circle one)

1. Diverger
2. Assimilator
3. Converger
4. Accommodator

Do you think that the results accurately describe your learning style?

(Yes) (No)

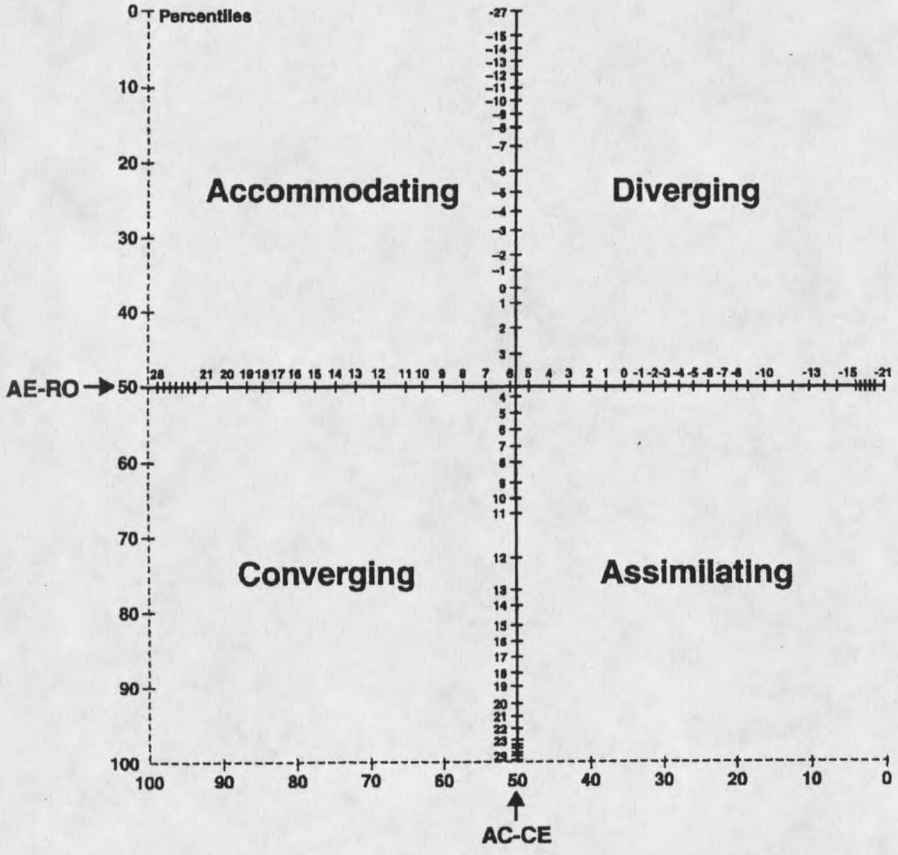
Comments:

APPENDIX D

LEARNING-STYLE TYPE GRID

MCB200D

LEARNING-STYLE TYPE GRID



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APPENDIX E

LEARNER TYPES

Learner Types

You may keep this page for your own reference.

Diverger - concrete experience, reflective observation
Experiences and reflects
Innovative Learners: want practical applications and to know how they will help them in the future

Assimilator - abstract, reflective observation
Thinks and reflects
Analytic Learners: like well ordered, logical presentations

Converger - abstract, active experimentation
Thinks and acts
Common Sense Learners: like to try it and see it

Accommodator - concrete experience, active experimentation
Experiences and acts
Dynamic Learners: like demonstrations and chances to explore

APPENDIX F

STUDENT INTERVIEW PROTOCOL

Student Interview Protocol

Pilot Questions:

Introduction: Talk about the study and the general findings.

Questions:

1. Do you find that your interactions with fellow students are affected by learning style preferences?
2. Do you find that your interactions with faculty are affected by learning style preferences?
3. Do you find that you interact better with some learning styles over others?
4. Do you find that some learning styles are more successful in the class than others?
5. Do you use one style of learning, or do you change often? What causes you to change you styles?
6. Do you find that students' learning styles affect their ability to succeed in class?
7. Did you find that knowing your learning style affected your ability to learn in class?
8. Do you find that faculty are more cognizant of learning styles in the classroom since the testing of learning styles in your class?

Review if necessary:
Divergers like brainstorming and using their imagination and like to work in groups. Assimilators like to assimilate diverse facts into theory, and like to validate ideas for themselves. They like "readings, lectures, exploring the analytical and having time to think things through. 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).

Interview Questions:

Introduction: Talk about the study and the general findings.

Questions:

1. What is your preferred learning style according to the Kolb Learning Style Inventory?
2. Did you find that knowing your learning style affected your ability to learn in class?
3. Describe in greater detail how you learn classroom material the best? How does that relate to the learning styles described by Dr. Kolb?
4. Do you change the way you learn according to different situations?
5. Do you find that some learning styles are more successful in the classroom than others? If so, how?

Review if necessary:
Divergers like brainstorming and using their imagination and like to work in groups. Assimilators like to assimilate diverse facts into theory, and like to validate ideas for themselves. They like "readings, lectures, exploring the analytical and having time to think things through. 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).

APPENDIX G

FACULTY INTERVIEW PROTOCOL

Faculty Interview Protocol

Questions:

1. What is the philosophy of your department?
2. What is an acceptable rate of completion for your program?
3. What is your retention rate? Why is it not what you want it to be?
4. Why do students drop out of your program?
5. Do you see a difference between the first year and second year students in the way that they learn?
6. What is the average tenure of your faculty with the program?
7. How do your teachers teach? Do they use a variety of teaching methods? Is there a systematic attempt to connect with the students?
8. What are your class sizes for lecture and lab?
9. What is the lecture to lab ratio?
10. How do you know that students are ready for graduation?
11. How do you know when a student is having trouble in the program? What steps do you take?

List of faculty interviewees

Audrey Connor-Rosburg, Licensced Practical Nursing Director, MSU-Billings College of Technology
Ellen Wirtz, Nursing Program Director, UM-Helena College of Technology
Margaret Wafstet, Program Director/Practical Nursing, UM-Missoula College of Technology
Jim Headlee, Program Coordinator/Diesel Equipment, UM-Missoula College of Technology
Ralph Rinehart, Department Chair/Trades and Industry, UM-Helena College of Technology
Tex Carpenter, Diesel Technology Faculty, MSU-Billings College of Technology

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