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Learning Styles of Physical Therapy and Physical Therapist Assistant Students in  
Accredited Physical Therapy Programs

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A dissertation

presented to

the faculty of the Department of Educational Leadership and Policy Analysis

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Doctor of Education in Educational Leadership

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by

Margaret A. Lowdermilk

May 2016

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Dr. Don Good

Dr. Jasmine Renner

Keywords: Learning Styles, Physical Therapy, Learning Preferences

## ABSTRACT

### Learning Styles of Physical Therapy and Physical Therapist Assistant Students in Accredited Physical Therapy Programs

by

Margaret Ann Lowdermilk

The purpose of this study was to determine the learning styles of Doctor of Physical Therapy (DPT) students and associate degree Physical Therapist Assistant (PTA) students and identify any association between their learning styles and examine the association between gender and age by learning style.

Participants included 337 DPT and PTA students attending CAPTE accredited institutions with doctoral DPT or associate PTA programs in Tennessee and southwest Virginia. The Felder (1996) and Soloman Index of Learning Styles (ILS) was used to determine learning style preferences within 4 learning style dimensions (active-reflective, sensing-intuitive, visual-verbal, and sequential-global).

Demographics included program of study, gender, age, ethnicity, and highest level of education. Participants were 18-63 years (mean age 25.87, standard deviation 5.62, median age 24); 205 (60.8%) DPT students, 132 (39.2%) PTA students; 205 (60.8%) female, 132 (39.2%) male.

Five research questions with 20 null hypotheses were evaluated using Cross-tabulated tables with frequency counts, percentages, and chi square tests. Statistical significance was established using an .05 alpha. Only 1 null hypothesis was rejected ( $H_{05_1}$ : There is no difference in the active-reflective learning style among PTA students by age). There was no significant difference between the learning styles of DPT and PTA students. Participants were found to be balanced on the active-reflective dimension, sensing on the sensing-intuitive dimension, visual on the visual-verbal dimension, and balanced on the sequential-global dimension; preferences were toward the active, sensing, visual, and sequential learning styles.

This study demonstrated that DPT and PTA students have a balanced learning style with a strong preference toward active, sensing, visual, and sequential. Therefore, teaching methods should provide an instructional environment that addresses these learning style preferences. The student's awareness of his or her learning style will enable the learner to capitalize on strengths and develop areas of weakness. This ability to employ effective learning strategies will equip an individual for the challenges of his or her chosen profession and lifelong learning.

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## DEDICATION

I dedicate this work in loving memory to my Mother and Father Mr. and Mrs. Frank Lowdermilk. Their legacy inspired a love for learning, provided the wit and wisdom to keep all things in perspective, and instilled a love for God that has continued to enrich my life. In honor of their memory this dedication is made with sincere appreciation for sacrifices made and support in accomplishing a lifelong dream.

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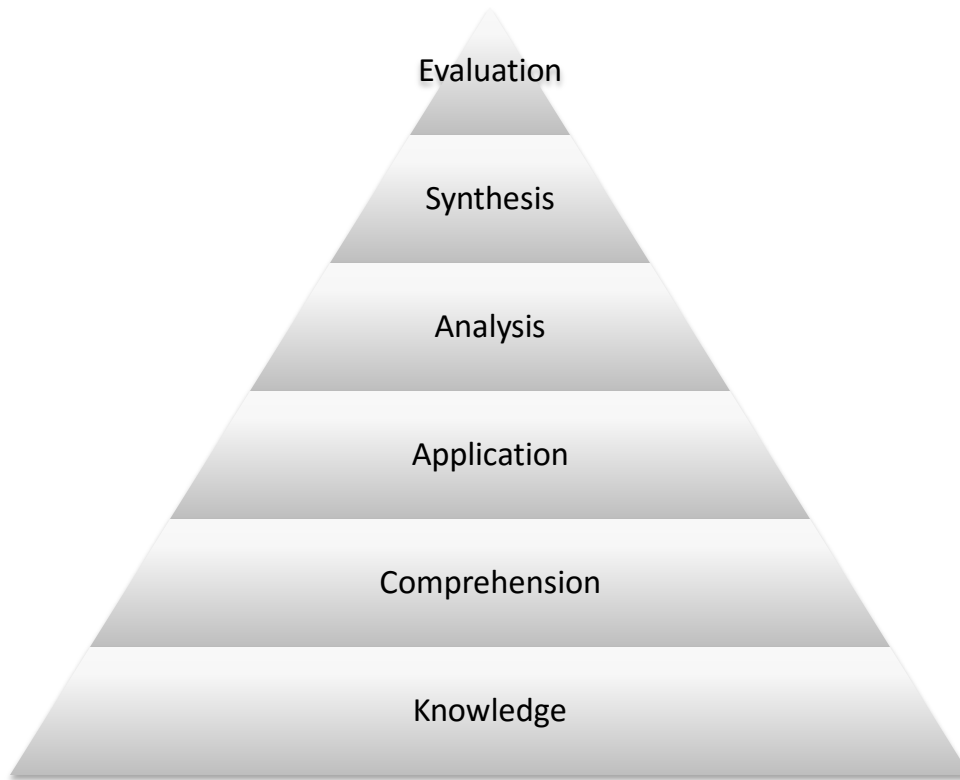
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## CHAPTER 1

### INTRODUCTION

Learning styles are as old and confusing as humankind. Intuitively we have known that individuals tend to have a preference for how they perceive their environment, process information, and operationalize that information. These preferences have become the basic tenets of the research surrounding learning styles. Over the past 40 years the concept of learning styles has engendered great controversy and support (Coffield, Moseley, Hall, & Ecclestone, 2004). Like many cognitive processes, the ability to understand or have an awareness of how one learns holds great promise for the individual and the educator.

In 1948 a group of educators led by Benjamin Bloom undertook the task of classifying intellectual behaviors that were believed to be important in the learning process. This classification or taxonomy was comprised of three domains: cognitive-knowledge domain comprised of six levels, affective-attitudinal domain comprised of five levels, and the psychomotor-skills domain comprised of six levels (Forehand, 2005). In 1956, eight years after the group first began their work, the cognitive domain handbook referred to as *Bloom's Taxonomy* was completed. Figure 1 represents the original Bloom's Taxonomy. This taxonomy or classification of intellectual behaviors is hierarchical and is used to describe lower and higher levels of thinking (Forehand, 2005).



*Figure 1.* Bloom's Taxonomy (old version) adapted from Forehand (2005).

Bloom's taxonomy has been amended and interpreted in various ways over the years but has clearly stood the test of time. In the mid 1990s Anderson who was Bloom's former student led a group of cognitive psychologists, curriculum theorists, and instructional researchers to consider updating Bloom's Taxonomy in an effort to keep pace with educational and societal changes that had occurred over 5 decades. In 2001 the *Revised Bloom's Taxonomy* was published. The major changes are represented by changes in terminology and the change from nouns to verbs for each category as represented in Figure 2 (Forehand, 2005).



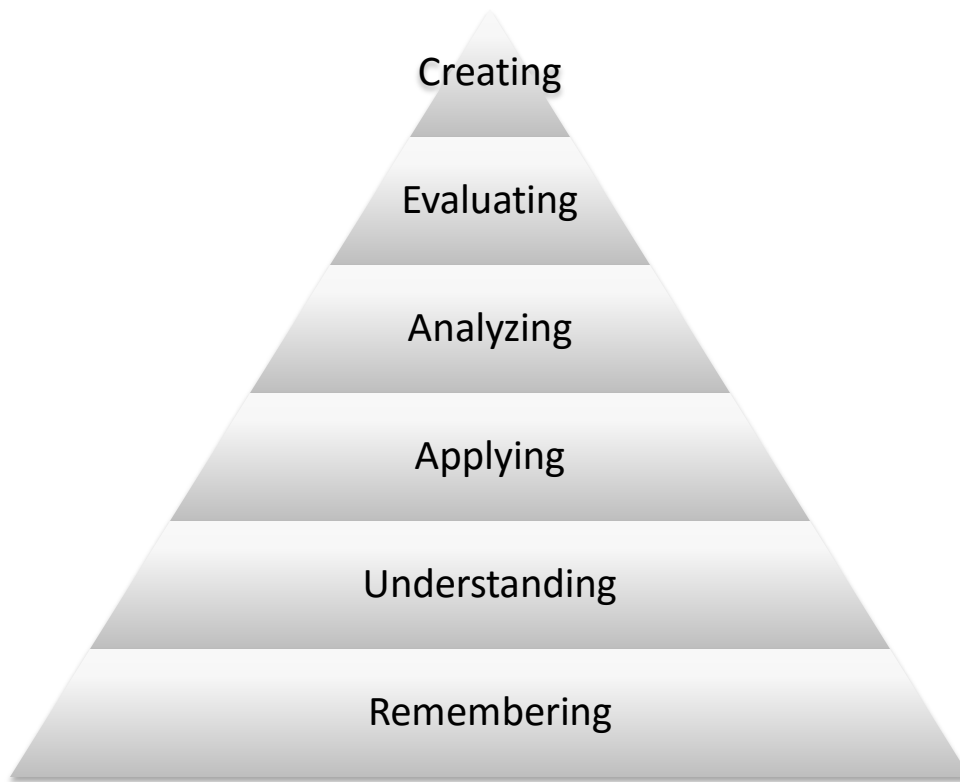


Figure 2. Bloom's Taxonomy (revised version) adapted from Forehand (2005).

“The revised Taxonomy is based on a broader vision of learning that includes not only acquiring knowledge but also being able to use knowledge in a variety of new situations” (Mayer, 2002, p. 226). *Learning* is based on the ability to retrieve information from long term memory; the process of remembering. Therefore, when the goal of instruction is retention, the important cognitive process is remembering. *Transfer* is the ability to use prior knowledge to construct new knowledge and involves not only recall but also understanding. One understands when connections are made between prior knowledge and new knowledge. A paramount goal of education should be the process of understanding. *Applying*, the third cognitive process, involves the ability to execute or use information to solve problems. *Analyzing*, the fourth cognitive process, involves breaking information into parts to determine how the parts are related. The next cognitive process is the ability to evaluate or make judgments or decisions based on criteria.

*Creating*, the final cognitive process is the ability to create new ideas or ways of putting elements together to form a whole (Mayer, 2002).

“Learning is the process whereby knowledge is created through the transformation of experience” (Kolb, 1984, p. 38). “Individuals use learning to adapt and manage everyday situations, giving rise to different styles of learning” (Soureshjani & Naserr, 2012, p. 70). Educators are in a unique position to empower students to achieve personal and academic success by helping them learn how to learn. Claxton and Murrell (1987) stated, “This experience of learning how to learn is an empowering one that can help students become successful lifelong learners” (p. 77). In 1982 the National Association of Secondary School Principals (NASSP) formed a task force to develop a learning style paradigm and by 1983 defined learning style as “a complexus of related characteristics in which the whole is greater than its parts. Learning style is a gestalt combining internal and external operations derived from the individual’s neurobiology, personality, and development and reflected in learner behavior” (Keefe & Ferrell, 1990, p. 59). The NASSP classified learning style into “cognitive, affective, and physiological/environmental domains” (Keefe & Ferrell, 1990, p. 59).

The insights gleaned from neurobiological and cognitive neuroscientific experimentation in humans and in animal models have identified many of the processes at the molecular, cellular, and systems levels that occur during learning and the formation, storage, and recall of memories. Moreover, with the advent of noninvasive technologies to monitor patterns of neural activity during various forms of human cognition, the efficacy of different strategies for effective teaching can be compared. (Friedlander et al., 2011, p. 415)

The functional change between neurons and within the network of neurons that enhances the communication between neurons is accomplished by changes in the brain’s structural circuitry. The brain’s structural circuitry was once thought to be static within adults, but evidence supports that mature brains can generate new neurons. The integration of the neurobiology of learning coupled with educational strategies and curricular design has provided valuable insights

to engage these processes to effectively facilitate learning, recall, retention, and the application of learned information (Friedlander et al., 2011). Decades of research by various scientists have culminated with the following 10 key aspects of learning and effective teaching.

1. Repetition – “With repetition or planned redundancies, many components of the neural processes that are engaged become more efficient (less energy used, more rapid neural execution, off-loading to lower-order pathways leaving higher-order pathways available for additional cognitive processing)” (Friedlander et al., 2011, p. 416). However, repetitions must be appropriately spaced.
2. Reward and Reinforcement – “*Reward* is a key component of learning at all stages of life” (Friedlander et al., 2011, p. 416)
3. Visualization – “Visualization and mental rehearsal are real biological processes with associated patterned activation of neural circuitry in sensory, motor, executive, and decision-making pathways in the brain” (Friedlander et al., 2011, p. 417).
4. Active Engagement – “There is considerable neurobiological evidence that functional changes in neural circuitry that are associated with learning occur best when the learner is actively engaged” (Friedlander et al., 2011, p. 417).
5. Stress – “Although the consequences of stress are generally considered undesirable, there is evidence that the molecular signals associated with stress can facilitate synaptic potentiation in brain circuits involved in the formation of memory” (Friedlander et al., 2011, p. 417). However, high levels of stress can have opposite effects.
6. Fatigue – “Patterns of neuronal activity that recapitulate the day’s events during sleep... research suggests that it is important to have appropriate downtime between intense

problem-solving sessions” (Friedlander et al., 2011, p. 418) to permit consolidation of memory.

7. Multitasking – Multitasking is a distraction from learning unless all of the tasks are relevant to the material being taught.
8. Individual Learning Styles – “The neural responses of these different individuals also show variability, and that is the rationale for embracing multiple learning styles to provide opportunities for all learners to be most effectively reached” (Friedlander et al., 2011, p. 418).
9. Active Involvement – “Doing is learning. And success at doing/learning builds confidence” (Friedlander et al., 2011, p. 418).
10. Revisiting Information and Concepts Using Multimedia – “Addressing the same information using different sensory processes [such as seeing and hearing] are likely to enhance the learning process” (Friedlander et al., 2011, p. 418).

Educators have recognized inherent preferences in the way they and their students absorb and process information. Cassidy (2004) in his overview of learning style theories, models, and measures contends there is a general acceptance of the importance of understanding how individuals learn and how one’s preference or inclination to approach learning situations impacts performance.

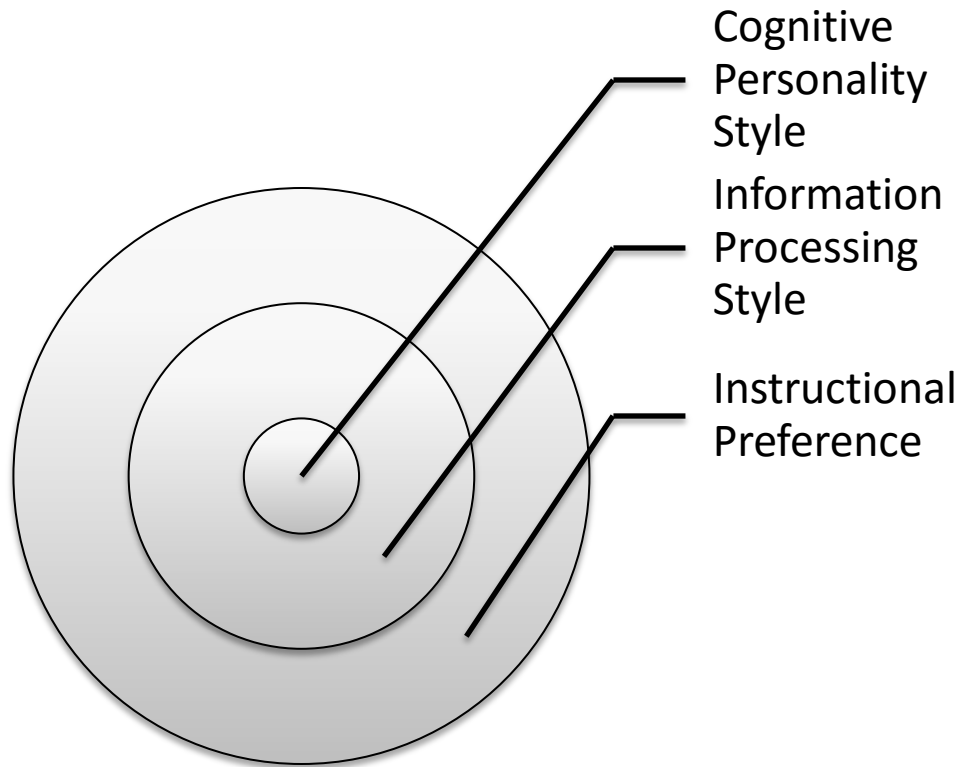
The emerging “global village,” where events in places we have barely heard of quickly disrupt our daily lives, the dizzying rate of change, and the exponential growth of knowledge all generate nearly overwhelming needs to learn just to survive. Indeed, it might well be said that learning is an increasing *occupation* for us all; for in every aspect of our life and work, to stay abreast of events and to keep our skills up to the “state of the art” requires more and more of our time and energy. (Kolb, 1984, p. 3)

Kolb's (date) words sound like they were written today as opposed to more than 3 decades ago. To better understand how we learn and preferences for how we take in and process information are paramount for educators and students alike as we all embark on a lifelong journey of learning. Lifelong learning is not an option for optimal work performance or growth as human beings and as members of our global society. The Pew Health Professions Commission recommended that healthcare professionals should learn basic competencies with an expectation that they continue to learn throughout their professional career. Professionals are also expected through their educational experience to be equipped with the critical skills to question and to incorporate evidenced-based practice throughout their years of practice (The Pew Health Professions Commission, 1995). It is paramount that healthcare professionals garner an understanding of how they learn and process information.

Because learning touches every aspect of our lives, approaches to better understand how we learn or theories of learning are found in relation to every world philosophy. For example, behaviorist theories assume that the environment shapes behavior; whereas, cognitive theories focus on internal processes to explain how information is received, processed, and interpreted (Mann, 2004). Transformations in the fields of cognitive psychology and education have led to an evolution of learning style theories over the past 40 years. Although learning styles and cognitive styles are used interchangeably by some, the difference is that cognitive style is the person's preferred approach of information gathering, processing, and interpretation whereas learning styles represent the resultant observable actions of those mental operations during the learning event or learning environment (Sandmire, Vroman, & Sanders, 2000). In the 1960s and early 1970s learning style and cognitive style research centered on individual differences; interest waned over time and left the field of learning style research incomplete and fragmented.

The fragmentation resulted in confusion over definitions and terminology and the meaning associated with cognitive style and learning style was primarily left to the researcher (Curry, 1983). Learning style emerged as the more common term in the 1970s. However, the term relied on the theoretical descriptions grounded in cognitive style research. The number of style elements provided some differentiation between terms with cognitive style providing a bipolar dimension and learning style representing many elements and not either/or extremes (Riding & Cheema, 1991).

Learning style theories, models, and instruments have been viewed from various perspectives and in diverse ways. Curry (1983) proposed to categorize nine of the learning style models into three stratum resembling layers of an onion. The outermost layer is instructional preference and is the most observable; it refers to the individual's preferred choice of learning environment, is susceptible to influence, and is least stable. The second layer of the learning style onion is information processing style and represents the individual's intellectual approach to assimilating information. Measures of this style should be more stable because this processing does not directly involve the environment. However, this information processing style is modifiable by learning strategies. The third innermost layer of the learning style onion is cognitive personality style. This style refers to the individual's approach to adapting and assimilating information that does not interact directly with the environment. This dimension is an underlying and relatively permanent personality dimension that is only apparent when an individual's behavior is observed across a variety of learning situations (Curry, 1983). Figure 3 represents the three learning style layers.



*Figure 3.* Curry's Onion Model adapted from Curry (1983).

The Experiential Learning Theory is an example of the information processing model developed by Kolb where learning is described as a process and concepts or ideas are not fixed but are continuously modified by experience (Kolb, 1984). Kolb's Experiential Learning Theory is principally derived from the work of Lewin, Dewey, and Piaget.

The ELT [Experiential Learning Theory] model portrays two dialectically related modes of grasping experience, Concrete Experience (CE) and Abstract Conceptualization (AC) – and two dialectically related modes of transforming experience – Reflective Observation (RO) and Active Experimentation (AE). Experiential learning is a process of constructing knowledge that involves a creative tension among the four learning modes that is responsive to contextual demands. This process is portrayed as an idealized learning cycle or spiral where the learner “touches all the bases” – experiencing, reflecting, thinking, and acting – in a recursive process that is responsive to the learning situation and what is being learned. (Kolb & Kolb, 2005, p. 2)

The Myers-Briggs Type Indicator (MBTI) is an example of the cognitive personality model; it classifies personality types and is one of the most widely used instruments for measuring personality differences. The MBTI measures preferences based on four scales derived

from Jung's Theory of Psychological Types (extroverts or introverts, sensors or intuitors, thinkers or feelers, and judgers or perceivers). These four indices produce 16 possible combinations referred to as types or styles. Each type has an associated set of preferred processes that are used more effectively and frequently by persons of that type. The MBTI not only measures personality preferences, but it measures a number of constructs that relate to learning styles (O'Brien, Bernold, & Akroyd, 1998).

The Index of Learning Styles (ILS) developed by Felder and Soloman classifies an individual's learning style on four dimensions (sensing or intuitive, visual or verbal, active or reflective, and sequential or global). Learning styles are preferences and tendencies that students have for certain ways of receiving and processing information. An educational objective should be to help students build the skills they need to be successful in both their preferred and least preferred mode of learning. The ability to work well in all learning style modes is required to function effectively in any professional capacity (Felder, 1996).

A growing number of physical therapists are exploring issues involving personality types and using their findings to enhance their own performance, increase job satisfaction, and leverage the strengths of their colleagues and patients. Bezner stated that skeptics might be tempted to poke holes in the research on personality type, citing the difficulties in measuring such a complex issue. Measuring human behavior is not an exact science but the rich theory that spans centuries upon which personality typing is based coupled with the practicality of understanding one's tendencies and style more deeply provides reassurance that personality tests can be very useful in physical therapy – where success depends heavily on the quality of relationships (Coyne, 2004).



The Pew Health Professions Commission (1995) reported an estimate of 10.5 million people (approximately 60% of the healthcare workforce) is comprised of allied health workers. The Department of Health and Human Services reported that allied health workers make up one of the fastest growing occupational groups with a 144% growth rate from 1970-1990. Allied health professionals are expected to work on interdisciplinary teams, attain new knowledge and skills to perform multiple functions across disciplines, and treat higher acuity patients effectively (The Pew Health Professions Commission, 1995).

The United States Bureau of Labor Statistics (US Department of Labor, 2015b) reported that the growth of employment for DPTs is expected to increase 34% from 2014 to 2024, which is greater than the average for all occupations. Demand for physical therapy services is due to an increase in the number of aging baby boomers who remain active later in life than previous generations (US Department of Labor, 2015b). The US Bureau of Labor Statistics (US Department of Labor, 2015a) also reported that PTA job growth is expected to increase 40% from 2014 through 2024. Employment growth is faster because of greater demand and an increase in the healthcare needs of a growing elderly population (US Department of Labor, 2015a). This increased demand is not only for DPTs and PTAs but also for highly skilled and technically competent allied health professionals. It is apparent that DPTs and PTAs must possess the ability to work in a team environment, foster relationships, and engage in lifelong learning.

The requisite skills necessary to graduate from a doctor of program in physical therapy or an associate degree program for physical therapist assistants only represents minimal competencies and must be augmented and sustained by lifelong learning to remain current in the field and provide best practice standards of care. College-level technical and professional

program content has a half-life of 4 years, which means the technical content is changing so quickly and so much that in about 4 years one's professional competencies must be renewed (Facione, 2015). Therefore, it is more important than ever before to have an awareness of and assess one's learning style to engender professional lifelong learning skills.

Physical therapy is defined as the care and services provided by, or under the direction and supervision of, a physical therapist. Physical therapists are the only professionals who provide physical therapy interventions. Physical therapist assistants are the only individuals who provide selected physical therapy interventions under the direction and supervision of the physical therapist. (CAPTE, 2014a, p. ii)

There are 233 accredited DPT programs in the United States; the number of students enrolled for 2015-2016 was 30,419 (CAPTE, 2016a).

Physical therapy, as a profession, dates from the beginning of the century, when the advances in health care made possible the survival of people affected by poliomyelitis and war injuries. Physical therapy has continued to evolve and to respond to the needs of society, with physical therapists now practicing in a variety of clinical settings with unprecedented levels of professional responsibility. Physical therapists are integral members of the primary care team and are involved in prevention of disability and promotion of positive health, as well as acting as consultants in restorative care. (CAPTE, 2014b, p. i)

The physical therapist assistant (PTA) is an integral part of the rehabilitative healthcare team. The Commission on Accreditation in Physical Therapy Education (CAPTE) specifically defines a PTA as "a technically educated health care provider who assists the physical therapist in the provision of physical therapy" (CAPTE, 2014b, p. i). The knowledge, skills, and abilities of the PTA professional have a profound influence on the patient's return to optimal function. The PTA is an associate degree-prepared healthcare professional. The PTA must pass the National Physical Therapy Exam for Physical Therapist Assistants and meet state licensure requirements to practice within that jurisdiction (state). There are 340 accredited PTA programs in the US and the number of students enrolled in those programs in 2015-2016 was 12,726 (CAPTE, 2016a).

Community college students are unique compared to the doctoral-prepared physical therapist student. The National Center for Education Statistics (NCES) reported

In 2006-07, there were 1,045 community colleges in the United States, enrolling 6.2 million students (or 35 percent of all postsecondary students enrolled that year)... Community colleges enroll a diverse group of students, with various reasons for going to college, and have larger percentages of nontraditional, low income, and minority students than 4-year colleges and universities. (Provasnik & Planty, 2008, p. iii)

The Center for Community College Student Engagement (CCCSE, 2012) reported that 59% of college students attended school part-time, 33% spent 11 hours or more per week caring for dependents, and 31% worked full-time. The differences between the DPT student and the PTA student are diverse and numerous. “Recognizing and defining the styles by which a person learns is as important to the learning process as diagnostic tests are to the healing process in the field of medicine” (Friedman & Alley, 1984, p. 77).

#### Purpose of the Study

DPTs and PTAs are important members of the healthcare team. An investigation of the learning styles of these team members is critical to prepare physical therapy students to meet academic and clinical challenges. Gaining an understanding of one’s preference for receiving and processing information will benefit the student, the healthcare team, and ultimately the patient. Assessment of learning style preferences enables students to organize and process information to their advantage. Also, knowledge of the various learning styles within a class helps instructors apply various pedagogical techniques. Educators are able to provide effective learning experiences based on preferred learning styles and strengthen nonpreferred learning styles only when the students’ learning styles have been identified (French, Cosgriff, & Brown, 2007).

As the field of physical therapy becomes more complex, the need for lifelong learning has become a fundamental skill and a necessary component in staying abreast of best practices. The PTA's role requires the development of inductive and deductive reasoning processes to provide optimum care for the patient and to support the DPT. Not only is there a paucity of information regarding the learning styles of DPTs and PTAs, research regarding their learning styles remains relatively untouched. The purpose of this study is to provide information about the learning styles of DPTs and PTAs. Learning styles are an important component of learning, imperative for effective team relationships within a challenging healthcare environment, and a critical component to become an effective life-long learner.

### Research Questions

The following five research questions guided this investigation:

- RQ1: Is there a significant difference between doctor of physical therapy students and physical therapist assistant students in each of the four learning styles of the Felder-Soloman Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?
- RQ2: Among doctor of physical therapy students is there a significant difference between male and female students in each of the four learning styles of the Felder-Soloman Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?
- RQ3: Among physical therapist assistant students is there a significant difference between male and female students in each of the four learning styles of the Felder-Soloman Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?

RQ4: Among doctor of physical therapy students is there a significant difference among age groups in each of the four learning styles of the Felder-Soloman Learning Styles

Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?

RQ5: Among physical therapist assistant students is there a significant difference among age groups in each of the four learning styles of the Felder-Soloman Learning Styles

Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?

#### Significance of the Study

Over the past 40 years learning styles have been studied in an attempt to help educators be more responsive to diverse student needs, communicate information in a more efficient way, and determine if students with specific learning style preferences are attracted to certain professions (Hauer, Straub, & Wolf, 2005). Felder and Brent (2005) agreed that if instructors understand the learning style differences in their class they have a better chance of meeting the needs of those diverse learners. However, it is impractical to even consider tailoring completely individualized instruction for each student in the class and just as impractical is the idea that if an instructor were to adopt only one approach to teaching that the needs of every student would be met (Felder & Brent, 2005). In the healthcare field a balance is needed to provide effective learning experiences based on preferred learning styles and the need to strengthen nonpreferred learning styles (French et al., 2007). The literature is replete with learning style data about baccalaureate and masters prepared nursing and various allied health professionals. However, there is a dearth of information related to the learning styles of community college allied health

students. This study will provide valuable information related to the DPT student and the PTA student.

This study will also contribute data to the already existing body of knowledge on the learning styles of allied health students. Specifically, this study will expand the body of knowledge by identifying the learning style preferences of PTA students. The results gleaned will help equip both educator and student with the tools to embark on a lifelong journey of learning and the integration of knowledge into clinical practice.

### Limitations

This study was limited to DPT and PTA students enrolled in Tennessee and southwest Virginia public universities or community colleges offering a clinical DPT or a PTA associate degree; therefore, the results of the study are not generalizable to other populations or geographic regions.

A second limitation of this study relates to the sample size of DPT and PTA students. This study was conducted with participants from selected DPT doctoral degree programs and PTA associate degree programs. Therefore, the sample size for this study may not be large enough to generalize to all DPT and PTA students.

A third limitation of the study relates to the population that represents community colleges and universities in Tennessee and southwest Virginia. This study included two public universities and four community colleges; therefore, the results are not generalizable to private colleges, online programs, or other institutions offering DPT and PTA programs.

A fourth limitation of the study hinges on the truthfulness of the study participants when answering Felder and Soloman's 44-question Index of Learning Styles (ILS) instrument. This

instrument assesses the student's learning style based on four defined dimensions. Accuracy of the data relies on the study participant's truthful and thoughtful answers to the questions.

### Definitions of Key Terms

The following terms are used throughout this investigation. For clarification of meaning they are defined here.

*Active-reflective learning style dimension* – “Active learners tend to learn while doing something active – trying things out, bouncing ideas off others” (Felder, 1993, p. 287). *Reflective learners* learn by “thinking things through before trying them out... reflective learners prefer to work alone or in pairs” (Felder, 1993, p. 287).

*CAPTE* – For the purposes of this study CAPTE refers to Commission on Accreditation in Physical Therapy Education.

*Cognitive style* – Cognitive style is the manner in which an individual prefers to gather, process, and interpret information (Sandmire et al., 2000).

*Critical thinking* – Critical thinking is “purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based” (Facione, 1990, p. 3).

*DPT* – For the purposes of this study DPT refers to the doctor of physical therapy degree that is a post-baccalaureate degree.

*Experiential learning* – “Experiential learning is the process whereby knowledge is created through the transformation of experience” (Kolb, 1984, p. 38).

*Index of Learning Styles® (ILS)* – “The Index of Learning Styles® (ILS) is a forty-four-item forced-choice instrument developed in 1991 by Richard Felder and Barbara Soloman to

assess preferences on the four scales of the Felder-Silverman model [dichotomous learning style dimensions]” (Felder & Brent, 2005, p. 61).

*Learning styles* – “Learning styles are preferences and tendencies students have for certain ways of taking in and processing information and responding to different instructional environments” (Felder, 2010, p. 4).

*PTA* – For the purposes of this study PTA refers to physical therapist assistant that requires a 2-year associate degree program from a CAPTE accredited program.

*Sensing-intuitive learning style dimension* – “*Sensing learners* (sensors) favor information that comes in through their senses” (Felder, 1993, p. 286); they are practical, concrete, and oriented toward facts and procedures. “*Intuitive learners* (intuitors) favor information that arises internally through memory, reflection, and imagination” (Felder, 1993, p. 286); they are conceptual, innovative, and oriented toward theories and meanings.

*Sequential-global learning style dimension* – “*Sequential learners* absorb information and acquire understanding of material in small connected chunks” (Felder, 1993, p. 287); they are more orderly and think in a linear fashion. “*Global learners* take in information in seemingly unconnected fragments and achieve understanding in large holistic leaps” (Felder, 1993, p. 287); these learners need to understand how the material being presented relates to their prior knowledge and experience. They are holistic, systematic thinkers and learn in large leaps.

*Visual-verbal learning style dimension* – “*Visual learners* get more information from visual images (pictures, diagrams, graphs, schematics, demonstrations)” (Felder, 1993, p. 286). Verbal learners prefer that information be presented via the written and spoken word.



## Overview of the Study

Chapter 1 provides an introduction to the study, concepts of learning style theories and models, and the research questions that guided the study. Chapter 1 also outlines the purpose and significance of the study with specific delimitations and limitations. Chapter 2 provides a comprehensive review of the literature related to this study that will serve to identify research that can be used as comparative measures, thereby adding relevance to the study. Chapter 3 describes the design of the study, research population, data collection instrument, instrument psychometrics, data collection process, and the research questions and corresponding hypotheses. In addition, chapter 3 identifies the methods used to gather and analyze data in this study. Chapter 4 presents the statistical analysis of the data collected and overall findings of this investigation. Chapter 5 discusses the significance of the findings in relation to other pertinent research and presents recommendations for practice and future study.

## CHAPTER 2

### REVIEW OF LITERATURE

#### Introduction

An understanding of how one learns and solves problems is of paramount importance not only for the student but how one interacts with the environment and manages everyday situations. Learning style is the strength and preferences of the way an individual takes in and processes information (Felder, 1996).

Human beings are unique among all living organisms in that their primary adaptive specialization lies not in some particular physical form or skill or fit in an ecological niche, but rather in identification with the process of adaptation itself – in the process of learning. We are thus the learning species, and our survival depends on our ability to adapt not only in the reactive sense of fitting into the physical and social worlds, but in the proactive sense of creating and shaping those worlds. (Kolb, 1984, 2015, p. 1)

It is important to understand how an individual learns best because an understanding of one's unique learning preferences can increase learning effectiveness. Learning is becoming an occupation for all of us; more of our time and energy is spent to stay abreast of events and keep our skills up-to-date. Learners must manage their learning to survive in this world of rapid change and exponential growth of knowledge (Kolb, 2015).

#### Learning Style Preferences

Interest in identifying preferences for how one learns is evidenced by a Google search on the term *learning styles*. An April 2016 search yielded 46,100,000 results in 0.31 seconds. Over the past 4 decades this intense interest in how people think and learn has led to the development of numerous theories and multiple taxonomies that often classify individuals into groups depending on their preferred way of taking in and processing information (for example visual versus auditory). Also, many learning style instruments have been developed for research and

pedagogical purposes (Hatami, 2013). The major theories and research related to learning and learning styles began in the field of psychology and quickly expanded into the area of education specifically looking at the relationship between teaching and learning. Various instruments were developed to assess one's style or preference for learning and much of the research was directed toward the validity, reliability, and other psychometric properties of the instruments.

During the 1960s and early 1970s research in learning styles was driven by an interest in individual differences. In the late 1970s and early 1980s the focus of psychological research shifted to between-group differences and left the investigation of learning styles uncompleted and fragmented. This fragmentation led to vast confusion of terminology and without a clear connection to education (Curry, 1983). "The term 'learning style' is widely used in both education and training to refer to a variety of constructs ranging from learning preferences to cognitive styles" (Sadler-Smith, 1996a, p. 185).

#### Field Dependence-Independence

Field dependence-independence was one of the first major theories related to learning styles developed by Witkin and his colleagues in the 1950s. The earlier work of Witkin (1950) such as the rod-and-frame test required subjects to disregard the tilted frame in order to bring a rod to a true vertical position; in the tilting-room-tilting-chair scenario participants established the position of their body without regard to its relation in the tilting room. These tests relied on the participant's perception to distinguish an upright orientation against a nonupright field. Witkin (1950) designed the ataxiameter device to assess forward-backward and left-right movement of the body while changing the conditions of the participant's visual field. Body-steadiness (balance) was calculated using the ataxiameter when the visual field was stationary

and when the visual field was unstable. Correlations were assessed between performances in all of the orientation tests.

Witkin's (1950) embedded-figures test required the participant to find a particular simple figure within a larger complex figure. The ability to distinguish the embedded figure independent from the background or field was a pervasive characteristic of a person's perception. The test examined a person's ability to analytically reflect on the field rather than to passively accept the field in which the embedded figures were incorporated without one's orientation being a factor in the test (Witkin, 1954). Witkin (1954) found that all of the perceptual tasks required separation of an item from its context. It didn't matter if the item was the subject's body or a visual figure; all required the perceptual function of active organization to keep the item separate from the background (Witkin, 1954). The perceptual tendencies revealed in the embedded-figures test are operational in all cognitive processes and may influence the manner in which one processes and the ease in which one solves problems (Witkin, 1950). In summary, Witkin's (1950) study of perception lead to the individual active, integrated, purposeful, and characteristic ways of coping in all situations to adjust and operate in relation to structure and the field (Witkin, 1954).

Witkin's (1950) field dependence-independence theory in which field independent people were easily able to see the figure because they were not confused by what surrounded it led to further cognitive style research. Messick (1976) reviewed the psychological findings to explore and apply the research on cognitive styles for higher education. Messick pointed to Witkin's widely-studied cognitive style of field dependence versus field independence as having a significant influence on higher education, specifically relating cognitive style to vocational preferences and choice of major. Messick (1976) suggested that individuals who had the same

cognitive style were able to get along with each other because of similar modes of communication that facilitate an understanding with each other.

Witkin (1954) extended the idea of field dependence-independence to learning styles, with some individuals being able to learn in relative isolation without relying on other information or issues, while other individuals learn through a more holistic method and rely on surrounding information or issues (Smith & Dalton, 2005). Field dependent individuals seem to successfully deal with circumstances that require interpersonal skills and social awareness while field independent individuals tend to deal better with situations requiring objective analysis (Riding & Cheema, 1991).

### Serialist-Holist

The serialist-holist theory was researched and developed by Pask (1976). His theory provided a theoretical basis for the classification of learning strategies and learning styles. Pask suggested that,

The holist has many goals and working topics under his aim topic; the serialist has one goal and working topic, which may be the aim topic.... Evidence suggests that the holist is assimilating information from many topics in order to learn the 'aim' topic, while the serialist moves on to another topic only when he is completely certain about the one he is currently studying. (Pask, 1976, p. 130)

In other words, some people (serialists) learn best in a more sequential manner by taking individual parts, learning each of them, and putting them together to form the whole. Others (holists) like to know the big picture first and then break down the individual parts as needed. Pask (1976) suggested that serialists ask narrow questions relating to a specific hypothesis, while holists ask broad questions relating to a more general hypothesis. He generalized that individuals demonstrated different learning strategies in the laboratory but more dramatically in the way they perceived, explored, processed, and learned about their environment.

Throughout his work, Pask observed that whereas serialists have a tendency to examine less data and use a step-by-step approach to confirm or disconfirm their hypothesis; holists in contrast, prefer to scan large amounts of data, searching for patterns and relationships. ... The serialists tend to put much more emphasis on the separate topics and the logical sequences connecting them only late in the process, ... the holists perceive the learning task in an overall context from the start. (Riding & Cheema, 1991, p. 204)

Pedagogical inference of both Pask and Witkin was that matching instruction with specific learning styles would enhance learning whereas unmatched instruction with specific learning styles would disrupt learning.

Student learning may be conceived in terms of the three stages of input, process and output. Input variables would include curriculum content and other features in the teaching context; process variables the ways a particular student has of going about selecting and learning from the input; and output variables the quality and quantity of subsequent performance. (Biggs, 1979, p. 381)

#### Operation vs. Comprehension Learning

Entwistle added another dimension to the three stages of learning (input, process, and output described by Biggs) and the serialist and holist styles of learning described by Pask. Entwistle described operation learning as a very narrow view of the topic being learned and linked to one who uses the serialist strategy of single facts and ideas, and the relationship between these ideas to build an understanding. In contrast, comprehension learning is linked to the holist strategy that involves building a conceptual map of the topic. Individuals who employ a holist strategy or a comprehension learning strategy link previous knowledge and experiences with new ideas, illustrations, and analogies to build a broad understanding of the topic or idea. However, this approach may lack the logical progression and detail provided by the serialist strategy (Entwistle, 1979).

Entwistle theorized that to fully comprehend ideas or topics a combination of operation learning and comprehension learning or having a versatile style to choose the learning strategy most appropriate for the task would yield a better learning outcome. In addition, comprehension

learning was associated with intrinsic motivation and a deep approach to learning whereas operation learning was associated with extrinsic motivation and a surface approach to learning (Entwistle, 1979). Entwistle found a clear connection between learning styles and areas of study. Operational learners tended to choose the sciences as an area of study; to gain an understanding of science courses required close examination of detail and logical progression of processes to master the content. However, it wasn't clear if students who preferred this style choose the sciences or if as part of their formative training they were taught to value logical processes over intuitive judgments (Entwistle, 1979).

In addition to his own research, Entwistle (1979) indicated a parallel between his theories and the styles or strategies expressed by Pask (1976) and Witkin (1954) with field-dependent students who aligned with holist comprehension learning and typically chose the arts, humanities, and social sciences whereas field-independent students (operation learners who can discern structure) typically chose science courses (Entwistle, 1979).

### Kolb's Experiential Learning Theory

Kolb's Experiential Learning Theory was used to develop the theoretical framework and most widely used learning style instrument. The Experiential Learning Theory is an information processing theory developed by Kolb where learning is described as a process and concepts or ideas are not fixed but are continuously modified by experience (Kolb, 1984). Kolb's Experiential Learning Theory is principally derived from the work of Kurt Lewin, John Dewey, and Jean Piaget.

The Experiential Learning Model (Figure 4) portrays four related modes of grasping or perceiving dimensions designed so that the learning cycle or spiral is a process whereby the learner touches all the bases (experiencing, reflecting, thinking, and acting) in a recursive process

that is responsive to the learning situation and to what is being learned (Kolb & Kolb, 2005).  
 “The ELT model portrays two dialectically related modes of grasping experience – Concrete Experience (CE) and Abstract Conceptualization (AC) – and two dialectically related modes of transforming experience – Reflective Observation (RO) and Active Experimentation (AE)”  
 (Kolb & Yeganeh, 2011, p. 3).

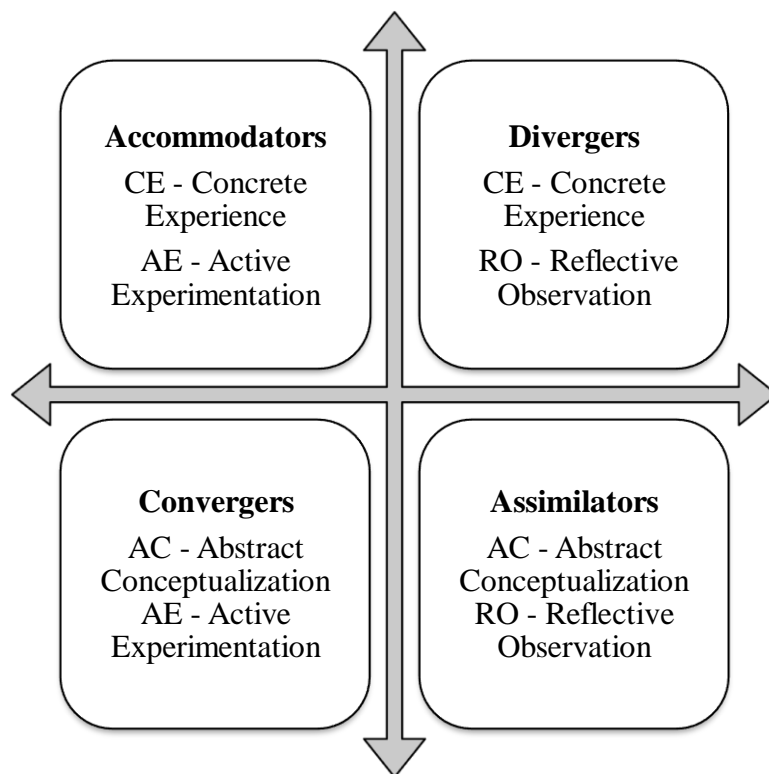


Figure 4. Kolb’s Learning Cycle adapted from Kolb Experiential Learning (1984).

Kolb defined learning as “the process whereby knowledge is created through the transformation of experience” (Kolb, 1984, p. 38) and expounded on the definition of learning by stating, “Knowledge results from the combination of grasping and transforming experience” (Kolb, 1984, p. 41). Grasping experience refers to the process of taking in information and transforming experience refers to how individuals interpret and act on that information.



Kolb suggested that learning does not happen in one big cycle but in small partial cycles and that our learning style determines where we begin the process of learning. Before resulting in action, it is likely that reflection, thinking, and experiencing will result in much iteration. One's learning effectiveness is increased when an individual can move from one learning mode to another within the learning cycle (Kolb, 2015).

Ultimately, however, it is the learner who manages their learning about learning and takes control of their learning process through meta-cognitive monitoring and control. Learners can chart their path on the learning way by developing their metacognitive learning capacities and educators can pave the way by placing learning about learning on the agenda of their educational programs. (p. 354)

Kolb developed a 2-dimensional learning style model based on the experiential learning cycle that depicted the opposing nature of the four learning abilities. The Y-axis is labeled as concrete experience versus abstract conceptualization and represents perceiving or the two modes of grasping experience. The X-axis is labeled as reflective observer versus active experimentation and represents the transformation or processing dimension of one's experience. The manner in which one takes in information or perceives new information lies somewhere on the perception continuum between concrete (sensing-feeling) and abstract conceptualization (thinking). In like manner, how one processes new information lies somewhere on the processing dimension continuum between active experimentation (doing) and reflective observation (watching) (Harb, Durrant, & Terry, 1993). The 2-dimensional Learning Style Grid provides four quadrants that correspond to Kolb's four learning styles (converger, diverger, assimilator, and accommodator). The four learning styles describe the learner's preference as to how to take in and process information in relation to each phase of the Experiential Learning Cycle. The converging learning style combines abstract conceptualization (AC) and active experimentation (AE). People with this learning style are good problem solvers and find a practical application of ideas but may not be good with social and interpersonal issues. The diverging learning style

combines concrete experience (CE) and reflective observation (RO). People with this learning style are imaginative, able to view concrete situations from various perspectives, and are feeling-oriented with an interest in others. The assimilating learning style combines abstract conceptualization (AC) and reflective observation (RO). People with this learning style are good at inductive reasoning and taking abstract ideas to create theoretical models but are less focused on people. The accommodating learning style combines concrete experience (CE) and active experimentation (AE). People with this learning style are good at carrying out plans, risk taking, and action but rely on others for information rather than their own analytic ability (Kolb, 1984).

Kolb also argued that a person may prefer one style in one situation, and another style in another situation, meaning that the position a person occupies in the two dimensional plane can vary with the learning task. However, Kolb also argued that in the same learning context the learning style adopted on each occasion is likely to be the same. (Smith & Dalton, 2005, p. 8)

Kolb developed the Learning Style Inventory (LSI) as a self-assessment tool to determine learning style in relation to the four quadrants of the Learning Style Grid. Kolb's LSI is the most frequently used method for assessing learning styles of allied health professionals (Hauer et al., 2005).

The Kolb model includes the two dimensions of perception (how we take things in) and processing (how we make things a part of us). The perception function can be represented as a line with the words *concrete* and *abstract* at opposite ends.... The manner in which any one individual perceives new information lies somewhere on this continuum. Processing new information can be performed actively on one extreme, or reflectively on the other. Again we can imagine a line representing a continuum with *active* and *reflective* at the opposite ends. (Harb et al., 1993, p. 70)

### The 4MAT Learning System

The 4MAT learning system was based on the four learning styles (quadrants) described by Kolb, except that it includes a question for each quadrant of *Why*, *What*, *How*, and *What if*. "The quadrant system, besides generally defining four learning styles is especially valuable as a

sequential cycle of learning” (McCarthy, 1982, p. 22). McCarthy not only added the questions for each quadrant but also “superimposed left and right mode techniques on each of the quadrants for learning styles and concerns” (McCarthy, 1982, p. 22).

4MAT is particularly distinctive among the myriad of learning styles theories in that it advocates taking all learners through all learning styles (not just one’s own favoured or preferred learning style), hence the innovative concept of a “cycle of learning.” (Gray & Palmer, 2001, p. 3)

The cycle or sequence is crucial to learning. Figure 5 shows the 4MAT Learning Cycle.

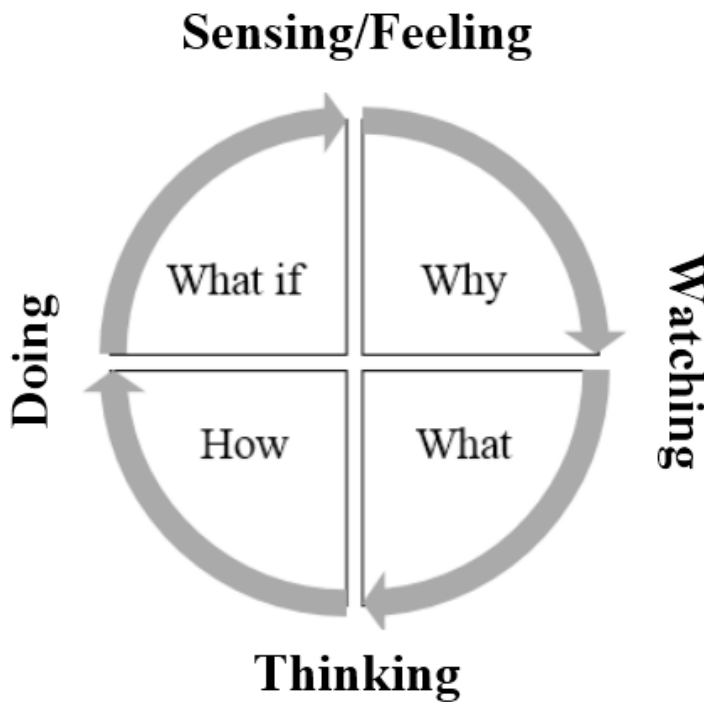


Figure 5. The 4MAT Learning Cycle.

A major premise of 4MAT is that learning differences are based on the way individuals perceive and process experience and information. The interactions between perception (sensing-feeling or thinking) and process (watching or doing) yield four types of learners, each with a unique set of motivations and needs. (Gray & Palmer, 2001, p. 3)

[In 1987] McCarthy [19] combined the Kolb and learning other theories to develop the 4MAT learning system that postulates that learning occurs best by passing through each of the four quadrants of the learning cycle.... Cyclical movement through each quadrant ensures that time is spent at each of the learning styles. (Ogot & Okudan, 2006, p. 566)

From an educational perspective each quadrant of the 4MAT learning system can be represented by each question and corresponding teaching methods: Quadrant 1 – *Why* – presenting basic information, introduce what the student will learn, motivate, connect new information with information previously processed, and provide the key to why I am learning this. Quadrant 2 – *What* – provide the information to solve the problem, integrate new information, and allow time to process. Quadrant 3 – *How* – application of information or material, develops problem solving skills, and creates a safe environment where it is okay to fail and learn from mistakes. Quadrant 4 – *What if* – self-discovery, create, and applying what the student learned in quadrant 3 to new and real life situations (Harb et al., 1993).

The [4MAT] learning cycle not only provides a model that we can use to improve our teaching, it provides a model that our students can use to teach themselves. With this ability to teach themselves, they will be better prepared for life-long learning in a world of rapidly changing technology. (p. 71)

### Gardner's Theory of Multiple Intelligences

Gardner advanced the theory of multiple human intellectual competences or intelligences. Gardner stated, "Only if we expand and reformulate our view of what counts as human intellect will we be able to devise more appropriate ways of assessing it and more effective ways of educating it" (Gardner, 1983, p. 4). Throughout history, "The unending search for an essence of humanity has led, with seeming ineluctability, to a focus upon our species' quest for knowledge; and those capacities that figure in knowing have been especially valued" (Gardner, 1983, p. 5). Gardner described seven intelligences in his book *Frames of Mind* (Gardner, 1983), which were further examined by Denig (2004).

- Verbal-linguistic learn best through reading, hearing, and seeing words and speaking, writing, discussing, and debating ideas.
- Math-logical learn best through working with patterns and relationships, classifying and categorizing, and working with the abstract.

- Spatial learn best in working with pictures and colors, visualizing and using the mind's eye, and drawing.
- Bodily kinesthetic learn best touching, moving, and processing knowledge through bodily sensation.
- Musical learn best with rhythm and melody, singing, and listening to music and melodies.
- Interpersonal learn best through sharing, comparing and relating with others, interviewing, and cooperating.
- Intrapersonal learn best through working alone, doing self-paced projects, and reflecting.
- Naturalists learn best when working in nature, exploring living things, and learning about plants and natural events. (Denig, 2004, p. 107)

Gardner advocated that individuals learn intuitively and proponents of multiple intelligences reason that making changes in methodology used in the classroom can enhance learning. Learning style proponents found that some students learn intuitively but some students require supervision and structure (Denig, 2004). Gardner's intelligences relate to one's potential and are not exactly the same as learning styles. However, one's intellectual strengths or intelligence enhance one's ability to process and learn information (Reese, 1998).

The essence of Gardner's theory is that individuals possess these intelligences in different quantities, such that their learning style is expressed as their combination of the intelligences, with their interests and talents being strongly related to the pattern in which they hold the intelligences. (Smith & Dalton, 2005, p. 9)

### Keefe's Learning Styles

In 1979 The National Association of Secondary School Principals published a book titled *Student Learning Styles Diagnosing and Prescribing Programs*. Educational reform was fostering an interest in learning styles, teaching methods, and individualization of instruction.

Keefe (1979a) stated,

[L]earning is a fascinating interactive process, the product of student and teacher activity within a specific learning environment. These central elements of the learning process, in turn, are subject to a wide variation in pattern, style, and quality. ... Moreover, the public, the press, and even many in the [education] profession have a generally simplistic view

of the relationship between the teaching-learning process and student achievement. (Keefe, 1979a, p. 1)

Keefe defined learning styles, as “characteristic cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with and respond to the learning environment” (Keefe, 1979a, p. 4). Learning is an internal process and learning styles are hypothetical constructs or persistent qualities that help explain the learning process. Affective, cognitive, and physiological styles are related to learning styles; however, learning styles is a much broader term that encompasses the affective, cognitive, and physiological dimensions of learning. Consequently, the student’s learning style, the teacher’s teaching style, and the learning environment all contribute to the learning process (Keefe, 1979a).

To further clarify these terms Keefe (1979a) defined cognitive styles as “information-processing habits; affective styles, motivational processes; physiological styles, biologically-based response modes” (p. 16). Teachers have long known that students differ in how they process and take in information. Some students learn best by doing, others by listening, and some by reading. Learning styles do not address *what* the student learns but *how* they learn. Therefore, certain educational approaches or teaching methods are more effective with some learning styles than with other learning styles. Hunt (1979) asked if students should be grouped with similar learning styles and matched to specific teaching styles or should teachers incorporate various teaching methods? “An understanding of the way students learn is the door to educational improvement. And learning style diagnosis is the key to an understanding of student learning” (Keefe, 1979b, p. 124).

## The Learning Style Profile

In 1982 the National Association of Secondary School Principals formed a task force to construct a learning style paradigm and to develop an instrument to assess learning styles. This task force focused on an eclectic approach by reviewing research representing aptitude-treatment interaction, personality theory, and cognitive style. By late 1983 the task force had classified learning styles into affective, physiological-environmental, and cognitive domains.

All subject matter must pass through the individual's information processing system to be learned, retained, and recalled. When information is received from the external environment through the senses and stored briefly in perpetual memory, the mind makes a decision about how to treat the message. It may reject the information, memorize it for short-term recall, transform it to conform to prior messages, or learn it by integrating, assimilating, differentiating, or associating it in working and long-term memory.... The gestalt of cognitive, affective, and environmental elements is what the task force called learning style. (Keefe & Ferrell, 1990, p. 59)

The task force developed an instrument to assess learning styles called the Learning Style Profile with much work centered on construct validity. However, a more significant result of the task force was to position learning styles as a stable construct within educational learning theory (Keefe & Ferrell, 1990).

## Deep vs. Shallow Processing

Schmeck (1981) studied learning styles from the perspective that elaborative or deep processing of information lead to longer lasting memory and understanding of the information presented. Schmeck concluded, "that the major learning style differences between successful and unsuccessful students concerns the extent to which they process deeply" (1981, p. 384). The elaborative process involved linking information to one's own experience by restating information in the student's own words, thinking of personal examples, or visually imaging personal illustrations of the material presented (Schmeck, 1981). Schmeck was interested in two important issues related to individual differences:

To what extent can we change a student's style from shallow-reiterative to more deep elaborative or, more specifically, can we help the learner adopt the style most appropriate to the material to be learned and to the testing conditions? (Schmeck, 1981, p. 385)

Interventions to encourage deep and elaborative include asking students for alternate ways to convey basic ideas presented in class, present examples of concepts, show how current concepts are interrelated with other ideas presented in class, and have students generate their own meaningful examples.

Another technique for developing a deep-elaborative style is through testing and homework. Tests are, of course, major vehicles for shaping student learning styles. If we demand regurgitation, we encourage shallow, reiterative memorization; if we test for comprehension of meaning, we encourage deeper, more elaborative, and thoughtful information processing. (Schmeck, 1981, p. 385)

In general, Schmeck (1981) theorized that facts do not exist in isolation but are related to other information and can be retained longer if processed in a personally relevant manner.

### Cognitive and Learning Styles

The mere concept and definition of style has led to confusion throughout the decades when defining cognitive and learning styles.

The concept 'style' is used in a variety of contexts, in high street fashion, the sports arena, the arts, the media and in many academic disciplines including educational psychology. It has a wide appeal that reflects an enduring versatility, but this same appeal can lead to overuse and often creates a difficulty for definition and understanding. The concept is nevertheless always associated with individuality and is invariably used to describe an individual quality, form, activity or behaviour sustained over time. (Rayner & Riding, 1997, p. 5)

Curry (1983) presented a benchmark paper at the 1983 Annual Meeting of the American Educational Research Association. She reported,

Studies in learning styles initially developed as a result of interest in individual differences. These issues were very much in vogue within investigatory psychology during the 1960's, enjoyed a continuing popularity during the early 1970's but have unfortunately past from vogue since then due to our society's changed focus or an evolution of professional interest. (p. 2)



Learning style research has been left incomplete and fragmented. “The operationalization of learning style theory encompasses three pervasive general problems: (1) confusion in definitions, (2) weakness in reliability and validity of measurements, and (3) identification of relevant characteristics in learners and instructional settings” (Curry, 1990, p. 50).

A style is different from an ability, strategy, or tactic. *Abilities* are competencies that are specific to particular content or skill areas... styles are not specific to particular tasks and no one value can be assigned to a style... Styles can be observed across content domains, abilities, personalities, and interpersonal behaviors, and they are measured in terms of typical performance.... *Strategies*, in contrast, are the result of conscious decisions... *Tactics* are specific, observable activities of individuals... in specific performance situations. (p. 409)

The array of definitions related to the concept of learning style, strategy, and tactic exist. However, there seems to be some agreement that style refers to information processing (Curry, 1990). Clarification of these similar but distinct terms is essential to gain an understanding of learning style literature. The following terms derived from Curry (1983) and Riding and Cheema (1991) provided the clearest classification of terms:

- Learning preference – the favoring of one particular mode of teaching over another.
- Learning strategy – adopting a plan of action in the acquisition of knowledge, skills, or attitudes.
- Learning style – a distinctive and habitual manner and distinct mode of acquiring knowledge, skills, or attitudes.
- Cognitive strategy – adopting a plan of action in the process of organizing and processing information.
- Cognitive style – a distinctive, systematic, and habitual manner of organizing and processing information.

Other authors (e.g. McLoughlin, 1999; Sadler-Smith, 1996a) have used the definitions derived from Curry (1983) and Riding and Cheema (1991) to clarify use of the five constructs often found in learning style literature.

[‘Learning style’], seems to have emerged as a more common term or a replacement term for cognitive style in the 1970’s. Indeed, the impression that is formulated in the usage of these terms is that those working under the umbrella of ‘learning style’, take cognitive style into consideration, but would probably describe themselves as interested in more practical, educational or training applications and are thus more ‘action-oriented’, while the term cognitive style has been reserved for theoretical, academic descriptions. Therefore, if cognitive style actually underlies learning style, it has quite practical implications. (Riding & Cheema, 1991, p. 194)

Learning style theories, models, and instruments have been viewed from various perspectives and in diverse ways. Curry (1983) proposed to categorize nine of the learning style models into three strata resembling the layers of an onion. The outermost layer is instructional preference. This layer is the most observable and refers to the individual’s preferred choice of learning environment; it is susceptible to influence and is least stable. The second layer of the learning style onion is information processing style. This layer represents the individual’s intellectual approach to assimilating information; measures of this style should be more stable because this processing does not directly involve the environment. However, learning strategies can modify the information processing style. The third innermost layer of the learning style onion is cognitive personality style. This layer refers to the individual’s approach to adapting and assimilating information and does not interact directly with the environment; this dimension is an underlying and relatively permanent personality dimension that is only apparent when an individual’s behavior is observed across many learning situations (Curry, 1983).

[The model] divided cognitive and learning style measures into groups based on the instrument developers’ intent to measure instructional preference, information processing tendencies and personality descriptors. The hypothesis accompanying the model was that the degree of temporal reliability in each dimension would vary depending on the main intent of the instrument: instructional preference being more easily modified than personality level traits. For example, measures of individuals’ instructional preference

would be less stable over time than would measures of personality dimensions. (Curry, 1991, p. 248)

### Cognitive Style Dimensions

Riding and Cheema (1991) described Curry's (1983) onion model in this way. The outermost layer is the most exposed to the external environment and most easily influenced by instructional preferences; it tends to be the least stable. The second layer is one's intellectual approach to taking in and processing information without environmental involvement. The third layer is the relatively permanent personality dimension that provides the basis for an individual's approach to adapting and assimilating information.

In the present context, a style is considered to be a fairly fixed characteristic of an individual, while strategies are the ways that may be used to cope with situations and tasks. Strategies may vary from time to time, and may be learned and developed. Styles, by contrast are static and are relatively in-built features of the individual. (Riding & Cheema, 1991, p. 196)

Riding and Cheema (1991) presented a cognitive style model in terms of two independent cognitive style dimensions. The first was the wholist-analytical dimension where the individual organizes or processes information globally or into component parts, in a way similar to Pask's (1976) serialist-holists theory. The second cognitive style dimension was the verbal-imagery dimension where the individual organizes or processes information verbally through words, reading, and listening or organizes and processes information through images or mental pictures (Riding & Cheema, 1991).

Sadler-Smith and Riding (1999) explored the relationship between an individual's cognitive style as defined by Riding and Cheema and the individual's instructional preferences. The results of the study clearly demonstrated that, "students' overall preferences were for dependent methods... using print-based media... and assessed by informal methods... The method

preferences score is particularly disconcerting, since one of the aims of higher education is to make learners ‘self-reliant’ and autonomous” (Sadler-Smith & Riding, 1999, p. 366).

### Matching Learning and Teaching Styles

As learning style research gained a pedagogical focus, researchers began to explore the idea of matching learning styles to teaching styles; matching hypothesis and the validity and reliability of various learning style instruments.

Learning style diagnosis opens the door to placing individualized instruction on a more rational basis. It gives the most powerful leverage yet available to educators to analyze, motivate, and assist students in school. As such, it is the foundation of a truly modern approach to education. (Keefe, 1979b, p. 132)

All of the major learning style and cognitive style theorists postulated that if an individual’s preference for how he or she processes and retains information is identified, then learning could be enhanced by matching teaching styles to preferred learning styles. However, if there is a mismatch between learning style and teaching style could the learner develop more adaptive skills and actually become a better lifelong learner?

Many models (ex. Kolb, Pask, 4MAT, Gardner’s Multiple Intelligences, etc.) and instruments to assess learning styles were developed during the mid 1970s and 1980s. “The essence of those models described similar phenomena observed from different vantage points – much like the blind men who were explaining an elephant by reporting only certain parts of its body” (Dunn, 1984, p. 11-12). Much of the research revolved around the psychometrics of the instruments used to assess learning styles and study designs. This research has led to controversy and complexity when trying to evaluate learning style models (Coffield et al., 2004; Curry, 1983; Dunn, 1984; Riding & Cheema, 1991). Another premise for gaining an understanding of learning styles is that the individual who understands his or her learning style is a more effective learner.

Learners who know their own style and/or preferences will make informed choices about what to engage with in learning, and which learning experiences and resources are likely to be attractive and useful, and which are not. Informed learners make good choices. (Smith & Dalton, 2005, p. 13)

There also seems to be a consensus between researchers and practitioners that no matter how different or similar the research outcomes, the body of knowledge surrounding learning styles will substantially contribute to the understanding of how one learns (Dunn, DeBello, Brennan, Krinsky, & Murrain, 1981). Dunn described learning style as “the way in which each person absorbs and retains information and/or skills; regardless of how that process is described, it is dramatically different for each person” (Dunn, 1984, p. 12). A few years later Dunn, Beaudry, and Klavas (1989) described learning style in the context of pedagogy.

Learning style is a biologically and developmentally imposed set of personal characteristics that make the same teaching method effective for some and ineffective for others.

Every person has a learning style – it’s as individual as a signature. Knowing students’ learning styles, we can organize classrooms to respond to their individual needs. (Dunn et al., 1989, p. 50)

Dunn’s learning style research strengthened the matching hypothesis by emphasizing that responsive instruction is based on identifying learning styles and that, “Those who suggest that children should learn to adapt to their teachers’ styles disregard the biological nature of style” (Dunn et al., 1989, p. 56).

No learning style is either better or worse than another. Since each style has similar intelligence ranges, a student *cannot* be labeled or stigmatized by having any type of style. Most children can master the same content; *how* they master it is determined by their individual styles. (p. 56)

The foundation of learning style research is the proposition that individuals process information differently. “The task of conducting construct validation research on tests of learning styles is essential if this field is to earn serious scientific credibility. Unfortunately, it appears that little has changed since Curry (1983) concluded her literature review” (Moran, 1991, p. 240). There is

a growing concern among learning styles researchers about such difficulties as the loose and inconsistent terminology found in field, the proliferation of tests whose construct validity is questionable and the doubtful status of the *matching hypothesis*.

Kaplan and Kies (1995) held the belief that learning is an internal process that is demonstrated by an observed change in the learner's behavior. Learning style may impact one's internal process and the relationship between learning and teaching does not directly correlate. "Learning style consists of distinctive and observable behaviors and provide clues about each individual. Learning styles emerge from inborn, natural predispositions. They need to be recognized, brought out, encouraged, unfolded, developed, and disciplined" (Kaplan & Kies, 1995, p. 31). Sadler-Smith (1996b) noted that confusion arose when the term learning style was used to specific learning constructs. "A more appropriate and all-inclusive term is 'personal style'. An individual's personal style may be thought of as consisting of a number of distinct but complementary attributes" (Sadler-Smith, 1996b, p. 30). Sadler-Smith also defined learning preferences as "an individual's propensity to choose or express a liking for a particular instructional technique or combination of techniques" (Sadler-Smith, 1997, p. 52).

### Changes in Learning Style

Another aspect of learning styles that caught the attention of researchers was to determine if learning styles changed over time and exposure to various experiences or if they remained relatively stable due to a strong connection to one's cognitive personality style. Loo (1997) examined changes in learning styles over a 10-week period. Kolb's Learning Style Instrument (LSI) 1985 version was administered at the beginning of the semester and again at the end of the semester. Test-retest correlations between first and second administration of the LSI were significant, indicating stability over time (Loo, 1997).

Learning styles are purported to be relatively stable characteristics; however, some change or development is also expected. Kolb does see individuals' progress from the concrete to the reflective observation to the abstract conceptualization to the active experimentation. Clearly, the effective learner is the person who adapts his or her learning style to the demands of the situation. (Loo, 1997, p. 95)

The results of a 3-year longitudinal study conducted by Pinto, Geiger, and Boyle (1994) found that learning styles of college students may exhibit change over the course of the student's college career.

In particular, three results of this study are noteworthy and are somewhat contradictory: (a) the relative long-term stability of students' learning attributes along the Y-dimension (abstract conceptualization minus concrete experience); (b) the significant changes along the X-dimension (active experimentation minus reflective observation); and (c) the mixed support for the stability in learning style classifications over the three years of the study. (Pinto et al., 1994, p. 117)

The debate, [concerning the stability of learning and cognitive styles] has important implications for the matching hypotheses. If cognitive style is stable then the only way of achieving a match between the trainee's learning style and learning activity is to develop a range of different learning activities... and allocate trainees to trainers on the basis of their learning style. (Hayes & Allinson, 1996, p. 66)

### Kolb's Experiential Learning Theory

Kolb's Experiential Learning Theory described how learners perceive information through concrete experiences or abstract conceptualization and process information using reflective observation or active experimentation (Kolb, 1984).

Therefore, the more an individual knows about his or her learning style, the more he or she becomes aware of how their learning style differs from that of others. This learner will be able to adapt better to situations in the classroom or on the job... as well as help them become more well rounded learners by utilizing more than one learning style. (Wolfe, Bates, Manikowske, & Amundsen, 2005, p. 18)

The most effective learners are able to work around the learning cycle and use all four learning styles (divergers, assimilators, convergers, and accommodators). Therefore, teachers should help students develop all types of learning styles (Wolfe et al., 2005). The core of Kolb's 1984 experiential learning theory is that "learners progress through a learning cycle in which

experience leads to observation and reflection, which then leads to concept formation” (McLoughlin, 1999, p. 228). “Learning styles research is of enormous significance with respect to establishing the learners’ contexts of application and learning, so that these understandings can be brought into the design process” (McLoughlin, 1999, p. 227). “By becoming better informed about their own learning preferences, students will increase their ability to develop additional learning styles and even modify their existing learning patterns” (Henson & Borthwick, 1984, p. 7). Generally, in most classrooms,

[L]earning style preferences are rarely, if ever, considered in a systematic fashion.... [It is not suggested] that instruction be guided solely by learning style preferences,... teachers should make informed decisions about the areas or units within which style differences can be incorporated. (Smith & Renzulli, 1984, p. 45)

Learning styles are typically bipolar entities (for example reflective versus impulsive, random versus sequential) representing two extremes of a wide continuum; however, where a learner falls on the continuum is value neutral because each extreme has its own potential advantages and disadvantages. (Hatami, 2013, p. 488)

### Learning Styles and Pedagogy

A benchmark review of learning styles and pedagogy in post-16 learning by Coffield et al. (2004) found many conceptual and empirical problems. The study of learning styles is not unified but divided into three areas (theoretical, pedagogical, and commercial) and characterized by a large number of small-scale applications with very few robust studies. This left most studies without reliable and valid evidence or clear implications for practice based empirical findings.

The review identified 71 models of learning styles. Some models offered new constructs or new labels for existing constructs to claim a new model (Coffield et al., 2004). Evidence about learning styles is guided by contrasting and disputed theories from psychology, sociology, education, and policy studies. These theories are valued in various ways from different perspectives. The problem is compounded by the way academic researchers develop their



reputations by establishing their territories and defending against different perspectives. This resulted in fragmentation with little cumulative knowledge and cooperative research.

The commercial gains for creators of successful learning style instruments are significant; therefore, critical engagement with the theoretical and empirical basis of their claims tends to be unwelcome. Learning styles has a strong intuitive appeal but has engendered much interest and controversy over the past decades. Learning style research, ideas about learning, and learning style models are endemic with conflicting assumptions.

Coffield et al. (2004) identified 71 learning style models but had grave concerns about whether these inventories had the theoretical basis to validate the pedagogical use or valid research surrounding the models. The Coffield review underscored the paucity of well-constructed experimental studies for most of the learning style models reviewed. Their review did not find one cognitive or learning style theory supported by longitudinal studies – particularly of twins – with support derived only from theoretical assumptions (Coffield, 2004).

Translating specific ideas about learning styles into teaching and learning strategies is critically dependent on the extent to which these learning styles have been reliably and validly measured, rigorously tested in authentic situations, given accurate labels and integrated into everyday practices of information gathering, understanding, and reflective thinking. (p. 10)

The Coffield et al. review did not support the *matching hypothesis* or linking teaching strategies to learning styles.

The sheer number of dichotomies betokens a serious failure of accumulated theoretical coherence and an absence of well-grounded findings, tested through replication.... In addition, the complexity of the learning styles field and the lack of an overarching synthesis of the main models, or of dialogue between the leading proponents of individual models, lead to the impression of a research area that has become fragmented, isolated and ineffective. (p. 136)

Following a scathing review, Markham (2004) conducted a review of general literature associated with learning styles rather than reviewing literature from psychology and educational

psychology and said, “There is, in effect, no data in the research literature that shows that learning styles are related to any learning outcomes, either qualitative or quantitative”

(Markham, 2004, p. 1).

This review of the literature on the measurement of learning styles, using devices not developed within the constraints of a behavioural learning theory, says that it is improper to use such measures. It is improper because they have not been shown to do what they purport to do. Therefore, any use can produce unpredictable results. In addition, use is not justified because few of the devices begin to meet the professional standards associated with measures that can influence human behavior. (Markham, 2004, p. 16)

Another review conducted by Pashler, McDaniel, Rohrer, and Bjork (2008) particularly assessed the matching or meshing hypothesis, whereby instructional methods would best match the preferences of the learner.

Although the literature on learning styles is enormous, very few studies have used an experimental methodology capable of testing the validity of learning styles applied to education. Moreover, of those that did use an appropriate method, several found results that flatly contradict the popular meshing/matching hypothesis. (p. 105)

The review also seems to link interest and influence of learning styles with the commercial aspect of various instruments to assess learning styles.

In recent decades, the concept of learning styles has steadily gained influence. Moreover, the learning-styles concept appears to have wide acceptance not only among educators but also among parents and the general public. This acceptance is perhaps not surprising because the learning-styles idea is actively promoted by vendors offering many different tests, assessment devices, and online technologies to help educators identify their students’ learning styles and adapt their instructional approaches accordingly. (p. 106)

“[T]he existence of study preferences would not by itself suggest that buying and administering learning-styles tests would be a sensible use of educators’ limited time and money” (Pashler et al., 2008, p. 108). Pashler et al. (2008) summarized their findings by stating,

The contrast between the enormous popularity of the learning-styles approach within education and the lack of credible evidence for its utility is, in our opinion, striking and disturbing. If classification of students’ learning styles has practical utility, it remains to be demonstrated. (p. 117)

“‘Learning styles’ as a concept is widely endorsed, geographically, across educational sectors and in many other domains of human activity” (Scott, 2010, p. 5).

[T]he continuing endorsement of ‘learning styles’ wastes teaching and learning time, promotes damaging stereotypes about individuals and interferes with the development of evidence-based best practice. It has no place in education theory and practice that claim to be scientifically based. (Scott, 2010, p. 14)

In response to the critical reviews of learning styles, Rayner (2007) did not discount the flaws of some of the learning style research but argued,

[C]ognitive style and learning styles remain important ideas and that rather than attempting to apply this theory as a simple, uniform, one-size solution for effective learning and teaching, it offers a rich potential for developing approaches to diversity and individual needs in the classroom. (p. 25)

In an editorial Richard Mayer responded to the Pashler et al. (2008) review by stating,

This kind of work is particularly noteworthy because it contributes to both improvements in educational practice (i.e., it has an applied goal) and to a more authentic theory of how people learn (i.e., it has a basic research goal). ... examining research on learning styles hypothesis helps to reinvigorate both educational practice and learning theory. (Mayer, 2008, pp. i-ii)

As the CEO of Respondus Inc. Smetters (2011) wrote the following in response to the Pashler et al. (2008) review,

Teaching styles matter. Learning styles matter. They are two sides of the same coin. It’s not whether a student has the *capacity* to learn a certain way. It is about offering compelling and competitive ways to get students to learn what you want them to learn. (para. 9)

Although there does not appear to be much support for matching learning styles with instruction, no one can argue with the fact that instructors need to be more sensitive to the individual differences of students in the classroom and may be more successful if they try different teaching methods with different students. (Dembo & Howard, 2007, p. 106)

### Reliability and Validity of Assessment Tools

When reviewing learning style research, one should remember that “a learning style approach focuses more on how students learn or fail to learn, and less on understanding how

subject matter should be taught” (Dembo & Howard, 2007, p. 106). As the controversy and debate continues in regard to learning styles and the psychometrics surrounding the reliability or validity of various learning style instruments, one must remember that assessment tools are just that – a tool and not an end unto itself.

The search for an assessment-led component for developing pedagogy for helping practitioners better meet individual learning needs in the classroom is part of an approach that argues for more attention to building a process-centered curriculum. It should not, does not, and cannot preclude other aspects of learning, teaching and, of course, the content of a curriculum. It must not be perceived as a substitute for knowledge content or a way of reducing the learner to a label or category. To interpret style in this way is a travesty. (Rayner, 2007, p. 29)

### Learning Styles in Allied Health Education

Learning style research is diverse, extensive, and has touched virtually every healthcare program of study. The value of learning styles to students, educators, practitioners, and patients cannot be overstated, especially in an age where technological advances push the boundaries of our imagination. Skills for lifelong learning, interpersonal skills, and communication skills are paramount for healthcare workers today.

The provision of healthcare has changed over the past decades with interdisciplinary teams providing highly specialized care concurrently. “If communication and hence performance, of teams is influenced by how team members view and interpret clinical information do other differences in information-processing styles impact team performance” (Sandmire et al., 2000, p. 143)? Various assessment tools to identify learning styles have been developed. However, the Kolb’s Learning Style Inventory (LSI) has become the most frequently used method for assessing learning style in health science literature (French et al., 2007; Hauer et al., 2005; Katz & Heimann, 1991; Sandmire et al., 2000; Wessel et al., 1999).

Research has been conducted to identify the learning styles of allied health students using various forms of the Kolb Learning Style Inventory. One such study found occupational therapist students were assimilators, nursing students were divergers, and physical therapist students were identified as convergers (Hauer et al., 2005). French et al. (2007) found that the two most prevalent learning styles for occupational therapist students were converger and diverger. In contrast, Katz and Heimann (1991) found that occupational therapy students and practitioners were accommodators.

Learning styles of allied health students were initially studied in the 1970s. Rezler and French (1975) developed their own Learning Preferences Inventory (LPI) and included six dimensions (abstract, concrete, individual, interpersonal, student-structured, and teacher-structured). Physical therapy students were high on teacher-structured, concrete, and interpersonal learning. Barris, Kielhofner, and Bauer (1985) found that both occupational therapist and physical therapist students preferred teacher-structured, concrete, and interpersonal learning. In addition physical therapy students showed less preference for teacher-structured learning compared the occupational therapy students. This study also found that physical therapy students valued wisdom, preferred abstract learning, and were satisfied with their education.

Peyton, Hueter, and McDonald (1979) studied learning style preferences of physical therapy students in the United States and found physical therapy and nursing students needed more organization and direct experience than all other groups studied. A study to identify the learning styles of Australian physiotherapy students found that the most frequently preferred learning style was assimilators (reflector) (Mountford, Jones, & Tucker, 2006). Another study found that a majority of Canadian physiotherapy students exhibited assimilative or convergent learning styles. Student in both groups (assimilative and convergent) used abstract

conceptualization as a predominant learning preference. The assimilators coupled this with reflective observation, whereas the convergers coupled this with active experimentation. Therefore, physical therapy students seem to learn by thinking and place less emphasis on personal involvement with people (Wessel et al., 1999).

### Critical Thinking in Allied Health Education

Another important dimension of allied health education and practice is the ability to critically reason or analyze. The California Critical Thinking Skills Test (CCTST) was developed to assess skills identified in the Delphi Report. The CCTST has 34 multiple-choice questions that assess a range of critical thinking skills. A higher score is associated with better critical thinking skills (Wessel & Williams, 2004).

Zettergren and Beckett (2004) conducted a study to evaluate the critical thinking skills of physical therapist students enrolled in a 5-year professional physical therapist education program to determine if critical thinking skills change over time. Their results showed a significant difference between the third-year and fifth-year students but no significant difference between the third-year and fourth-year students.

Vendrely (2005) conducted a study to determine if critical thinking skills change after completing a 27-month physical therapist professional education program. The pretest and posttest results showed no significant difference in critical thinking skills. A study using the California Critical Thinking Skills Test (CCTST), the California Critical Thinking Disposition Inventory (CCTDI), and the Kolb Learning Style Inventory (LSI) examined if there was an association between learning styles and critical thinking; the results were used to compare critical thinking ability (skills) and critical thinking disposition of physical therapist students in a master's entry level program. No association was found between critical thinking and learning

styles. Also, no significant difference was found between critical thinking skills and disposition during the program (Wessel & Williams, 2004).

### Changes in the Brain During Learning

A basic assumption underlying learning is that learning brings about change. However, neuroscience is providing a deeper understanding of the neurobiological changes that occur in the brain when we learn and remember. “Sometimes learning is incremental, and we don’t even notice the changes.... In the most dramatic cases, learning transforms our life” (Zull, 2004, p. 68). Neurological plasticity is an area of research that has provided insight as to how the brain changes in response to various inputs and stimuli. When we think of the brain being *plastic* it means,

[T]he brain changes its own wiring, perhaps almost continuously. Like a piece of silly putty, the brain is molded and reshaped by the forces of life acting on it. Our wiring grows and develops depending on what we experience – even before birth. As we interact with the world, the world becomes internalized, or mapped, in our brain. The extensive plasticity of the brain continues throughout life. (p. 69)

What is becoming clearer is the cycle of learning proposed by Kolb (1984) that shows a neurological basis.

A useful, although greatly simplified, way to view the cerebral cortex is to divide it into four major regions with different functions... *sensory cortex* (getting information); *integrative cortex near the sensory cortex* (making meaning of information); *integrative cortex in the front* (creating new ideas from these meanings); and *motor cortex* (acting on those ideas). (Zull, 2004, p. 72)

Research using visual (pictures, images) and verbal (words) learners is not new and remains as one of the bipolar constructs when addressing visual and verbal learners. However, the question remains as to how cognitive style and abilities interact with learning preferences.

Research using Functional Magnetic Resonance Imaging (fMRI), suggested,

[C]ognitive styles are associated with processing information in one’s preferred modality, even when it is presented in a nonpreferred form (e.g., converting visual information into

a verbal working memory representation)... [This research] provides a useful first description of the biological basis of these individual differences in cognition. (Kraemer, Rosenberg, & Thompson-Schill, 2009, pp. 3792-3793)

Choi and Sardar (2011) found that,

Mental rotation abilities, a specific type of spatial ability, was the sole predictor of visual cognitive style, such that those with better developed mental rotation abilities tended to self-identify as visualizers. Congruently, higher vocabulary scores predicted verbal cognitive style; students with more developed vocabulary abilities were more likely to identify themselves as verbalizers. (p. 6)

Taken together, these results suggest that specific cognitive abilities, namely, mental rotations and vocabulary, predicts visual and verbal cognitive style, respectively. Visual cognitive style, in turn, predicts visual learning preferences. The analogous relationship between verbal cognitive style and verbal learning preferences did not emerge. It is plausible that specific cognitive abilities bias individuals to develop visual or verbal cognitive styles, which then may influence learning preferences, particularly in the case of visual cognitive style. (p. 7)

Kraemer et al. (2009) found that,

[B]rain activity that was correlated with cognitive styles was found during the tasks that were presented in the nonpreferred modality (word-word for visual style and picture-picture for verbal style). This novel finding suggests that an important feature of processing in a specific cognitive style is that when one encounters a stimulus that is presented in a nonpreferred modality, one mentally converts that information into his or her preferred modality.... it may be the case, given proper training or motivation, that an individual can effectively learn to adopt a new cognitive style if doing so would facilitate problem solving in a specific domain. For example, a student who prefers the verbal style may be able to learn to visualize in certain situations where it would be helpful for a specific subject, such as organic chemistry. (p. 3797)

The advances in neurological research may shed new light on cognitive styles, learning styles, and teaching methods.

### Chapter Summary

Careful attention to the learning style literature demonstrates that there are a variety of opinions and definite flaws in the research, but no one refutes the idea that individuals have preferred ways of taking in and processing information. "We each are born with predisposition for learning in certain ways. We also are products of external influences, especially within our



immediate family, extended community, and culture” (Guild, 2001, The Nature vs. Nurture Issue, para. 1).

[A] key to educational and professional success is the ability to adapt to different situations – including adapting one’s learning style. Style flexibility is required for choosing or developing an appropriate strategy for and employing appropriate tactics in a novel situation. (Curry, 1999, p. 411)

Flexibility in learning styles is echoed by Loo (2002), “There appear to be substantial benefits to students who develop the ability to adopt different learning styles in different situations, recognize their own learning strengths and preferences, and approach learning situations with flexibility” (Loo, 2002, p. 256). Will learning styles remain relevant within educational theory and pedagogic concepts? Despite the controversy and debate concerning learning styles and the validity of learning style measurement instruments,

[E]fforts to better define and utilize learning style theory is an area of growing research. A better knowledge and understanding of learning styles may become increasingly critical as classroom sizes increase and as technological advances continue to mold the types of students entering higher education. (Romanelli, Bird, & Ryan, 2009, p. 4)

With debate and controversy surrounding decades of psychological and educational research on learning styles, the advances in neuroscience and Functional Magnetic Resonance Imaging (fMRI) may provide empirical evidence for individual differences associated with preferences and lend support for evidenced-based instructional and teaching practices.

## CHAPTER 3

### RESEARCH METHODOLOGY

The purposes of this study was to determine the learning styles of doctor of physical therapy (DPT) students and physical therapist assistant (PTA) students and identify any association between their learning styles. In addition, this study examined the learning style dimensions frequently associated with DPT and PTA students. This study also examined the association between demographic characteristics and learning styles. This chapter describes the research design, study population, data collection procedures, data collection instrument, psychometrics of the instrument, the research questions, and null hypotheses.

A nonexperimental study design using a convenience sample was used to examine learning styles of students enrolled in the first, second, and third year of DPT education programs and during the first and second year of PTA education programs at selected Commission on Accreditation in Physical Therapy Education (CAPTE) (2016a) accredited universities and community colleges in Tennessee and southwest Virginia. Learning style and demographic data were gathered from each study participant. Approval from the East Tennessee State University (ETSU) Institutional Review Board was obtained before the start of the study.

#### Research Questions and Null Hypotheses

The research was directed by five research questions with four corresponding null hypotheses each. To answer each research question, the chi square test was used to evaluate the corresponding four null hypotheses.

RQ1: Is there a significant difference between doctor of physical therapy students and physical therapist assistant students in each of the four learning styles of the Felder-Soloman

Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?

Ho<sub>1</sub><sub>1</sub>: There is no difference in the Active and Reflective Learning Style (active, balanced, and reflective) between doctor of physical therapy students and physical therapist assistant students.

Ho<sub>1</sub><sub>2</sub>: There is no difference in the Sensing and Intuitive Learning Style (sensing, balanced, and intuitive) between doctor of physical therapy students and physical therapist assistant students.

Ho<sub>1</sub><sub>3</sub>: There is no difference in the Visual and Verbal Learning Style (visual, balanced, and verbal) between doctor of physical therapy students and physical therapist assistant students.

Ho<sub>1</sub><sub>4</sub>: There is no difference in the Sequential and Global Learning Style (sequential, balanced, and global) between doctor of physical therapy students and physical therapist assistant students.

RQ2: Among doctor of physical therapy students is there a significant difference between male and female students in each of the four learning styles of the Felder-Soloman Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?

Ho<sub>2</sub><sub>1</sub>: Among doctor of physical therapy students there is no difference in the Active and Reflective Learning Style (active, balanced, and reflective) between male and female students.

- Ho2<sub>2</sub>: Among doctor of physical therapy students there is no difference in the Sensing and Intuitive Learning Style (sensing, balanced, and intuitive) between male and female students.
- Ho2<sub>3</sub>: Among doctor of physical therapy students there is no difference in the Visual and Verbal Learning Style (visual, balanced, and verbal) between male and female students.
- Ho2<sub>4</sub>: Among doctor of physical therapy students there is no difference in the Sequential and Global Learning Style (sequential, balanced, and global) between male and female students.
- RQ3: Among physical therapist assistant students is there a significant difference between male and female students in each of the four learning styles of the Felder-Soloman Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?
- Ho3<sub>1</sub>: Among physical therapist assistant students there is no difference in the Active and Reflective Learning Style (active, balanced, and reflective) between male and female students.
- Ho3<sub>2</sub>: Among physical therapist assistant students there is no difference in the Sensing and Intuitive Learning Style (sensing, balanced, and intuitive) between male and female students.
- Ho3<sub>3</sub>: Among physical therapist assistant students there is no difference in the Visual and Verbal Learning Style (visual, balanced, and verbal) between male and female students.

Ho3<sub>4</sub>: Among physical therapist assistant students there is no difference in the Sequential and Global Learning Style (sequential, balanced, and global) between male and female students.

RQ4: Among doctor of physical therapy students is there a significant difference among age groups in each of the four learning styles of the Felder-Soloman Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?

Ho4<sub>1</sub>: Among doctor of physical therapy students there is no difference in the Active and Reflective Learning Style (active, balanced, and reflective) based on age.

Ho4<sub>2</sub>: Among doctor of physical therapy students there is no difference in the Sensing and Intuitive Learning Style (sensing, balanced, and intuitive) based on age.

Ho4<sub>3</sub>: Among doctor of physical therapy students there is no difference in the Visual and Verbal Learning Style (visual, balanced, and verbal) based on age.

Ho4<sub>4</sub>: Among doctor of physical therapy students there is no difference in the Sequential and Global Learning Style (sequential, balanced, and global) based on age.

RQ5: Among physical therapist assistant students is there a significant difference among age groups in each of the four learning styles of the Felder-Soloman Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?

Ho5<sub>1</sub>: Among physical therapist assistant students there is no difference in the Active and Reflective Learning Style (active, balanced, and reflective) based on age.

Ho5<sub>2</sub>: Among physical therapist assistant students there is no difference in the Sensing and Intuitive Learning Style (sensing, balanced, and intuitive) based on age.

Ho5<sub>3</sub>: Among physical therapist assistant students there is no difference in the Visual and Verbal Learning Style (visual, balanced, and verbal) based on age.

Ho5<sub>4</sub>: Among physical therapist assistant students there is no difference in the Sequential and Global Learning Style (sequential, balanced, and global) based on age.

### Sample

The participants in this study included DPT and PTA students attending CAPTE accredited universities or colleges that offer a DPT program or PTA associate program in Tennessee and southwest Virginia.

Participants in this study represented DPT students from two universities and PTA students from four community colleges who agreed to participate in this study. The participants were enrolled during the fall semester of 2015 at one of the participating institutions. DPT students attending one of the two universities were in their first, second, or third year of a doctoral degree program. PTA students attending one of the four community colleges were in their first or second year of an associate degree program.

The Commission on Accreditation in Physical Therapy Education (CAPTE) is the only accreditation agency recognized by the United States Department of Education (USDOE) and the Council for Higher Education Accreditation (CHEA) to certify entry-level DPT and PTA

education programs (CAPTE, 2016b). Accreditation is a valuable service to the public, students, educational institutions, the programs, and the profession to assure that graduates from an accredited program meet standards set by the profession. CAPTE accredits first professional (entry-level) programs in the US for DPTs at the master and doctoral levels and for PTAs at the associate level. CAPTE assures quality and continuous improvement by establishing and applying standards in the preparation of DPTs and PTAs. Accreditation assures that standards reflect the evolving nature of education, research, and practice and are adhered to by universities and colleges offering entry-level preparation of DPTs and PTAs (CAPTE, 2015).

### Description of the Sample

There were 337 student participants in this study. Demographic data collected included program of study, gender, age, ethnicity, and highest level of education obtained in any area prior to the current program of study. Participants' ages ranged from 18 to 63 years with a mean age of 25.87 and standard deviation of 5.62; the median age was 24. Of the 337 participants 205 (60.8%) were doctor of physical therapy (DPT) students and 132 (39.2%) were physical therapist assistant (PTA) students. There were 205 (60.8%) female and 132 (39.2%) male participants. Among female participants 121 (59.0%) were DPT students; among male participants 84 (63.6%) were DPT students.

### Highest Level of Education

Table 1 shows that the majority of participants held a baccalaureate degree as the highest level of education prior to beginning the current program of study. There were 91 (27.0%) participants holding an associate degree or lower, 237 (70.3%) participants at the Baccalaureate level, and nine (2.7%) holding a masters or higher degree.

Table 1

*Frequencies and Percentages for Respondents' Highest Level of Education*

Highest Level of Education	<i>N</i>	%
High School Diploma or GED	72	21.4
Associate	19	5.6
Baccalaureate	237	70.3
Master's	8	2.4
Doctorate	1	0.3
<i>Total</i>	<i>337</i>	<i>100.0</i>

Data Collection Instrument

Researchers have studied learning styles for the past 40 to 50 years with great interest, confusion, and controversy. Rezler and French (1975) developed the Learning Preferences Inventory (LPI) to examine the learning preferences of students in six allied health professions. Peyton et al. (1979) chose the Learning Styles Inventory developed by Canfield and Lafferty to examine the learning style preferences of physical therapy students in the US. Barris et al. (1985) used Rezler's Learning Preferences Inventory to examine the learning preferences of occupational therapy and physical therapy students. Mountford et al. (2006) studied the learning styles of entry-level physiotherapy students by employing the Honey and Mumford Learning Style Questionnaire (LSQ). Many researchers to examine the learning styles of health professionals (French et al., 2007; Hauer et al., 2005; Katz & Heimann, 1991; Wessel et al., 1999; Wessel & Williams, 2004) have used the Kolb Learning Style Inventory (LSI) extensively.

Coffield et al. (2004) review of learning style literature identified 71 learning style models and instruments that categorized each model based on how the developer of the model viewed learning styles on a continuum of fixed trait to fluid trait theories. Of the 71 learning style models identified, the review focused on 13 major models with each model having many empirical and conceptual problems (Coffield et al., 2004). Learning style models developed by



Kolb, Honey and Mumford, McCarthy, and Felder and Silverman were categorized within the same family of learning styles defined as flexibly stable learning preferences (Coffield et al., 2004). The Felder and Soloman Index of Learning Styles (ILS) instrument developed in 1991 was used in this study to ascertain the learning styles of DPT and PTA students. The ILS instrument was adapted from the Felder and Silverman model developed in 1987. Felder defined learning styles as “characteristic strengths and preferences in the ways they [individuals] take in and process information” (Felder, 1996, p. 18).

*A learning styles model* specifies a small number of dimensions that collectively provide a good basis for designing effective instruction. Like all models in the physical, biological, and social sciences, they are incomplete but potentially useful representations of reality, and should be judged by how well they characterize and interpret observations and inform professional practice. (Felder, 2010, p. 1)

Considering the plethora of learning style models and instruments to assess learning styles the Felder and Silverman model was chosen for this study because the model dimensions were formulated from studies particularly relevant to science education (Felder, 1993). The Felder and Silverman model was designed to be particularly applicable to assess learning style differences among engineering students and identify learning preferences based on four dimensions (Felder & Spurlin, 2005):

- *sensing* (concrete, practical, oriented toward facts and procedures) or *intuitive* (abstract thinker, innovative, oriented toward theories and underlying meanings);
- *visual* (prefer visual representations of presented material, such as pictures, diagrams and flow charts) or *verbal* (prefer written and spoken explanations);
- *active* (learn by trying things out, enjoy working in groups) or *reflective* (learn by thinking things through, prefer working alone or with a single familiar partner);
- *sequential* (linear thinking process, learn in small incremental steps) or *global* (holistic thinking process, learn in large leaps). (Felder & Spurlin, 2005, p. 103)

The Index of learning Styles (ILS) has several advantages compared to other familiar instruments such as the Kolb’s Learning Style Inventory or Myers-Briggs Type Indicator due to its ease of administration (Zywno, 2003).

The [Index of Learning Styles] (ILS) consists of 44 two-part ('a' and 'b') items, designed to provide scores on the four hypothesized bipolar scales. Each item is treated as contributing to only one of the four scales. There are 11 items for each of the four scales. Total scale scores are computed by summing the scores on the 'a' parts of relevant questions/items and subtracting the sum of the relevant 'b' parts (or vice versa if the 'b' total is greater than the 'a' total). As there are an odd number of items for each scale, a preference will emerge if the respondent completes all items as directed.... The general style of the items is that a short sentence introduces the two parts. (Van Zwanenberg, Wilkinson, & Anderson, 2000, p. 370)

Felder and Soloman developed the 44-item forced-choice ILS instrument to assess preferences on the four scales of the Felder and Silverman model (Felder & Brent, 2005). A pencil-and-paper version of the instrument was put on the Internet in 1996 and an online version was made available in 1997. Permission was obtained from Dr. Richard Felder to use the Felder-Soloman ILS instrument (Appendix A) and the Index of Learning Styles Report Form (Appendix B). The ILS is available at no cost to individuals who wish to assess their own preferences and to instructors and students who wish to use it for classroom instruction or research (Felder & Spurlin, 2005).

For statistical analyses, it is convenient to use a scoring method that counts 'a' responses, so that a score on a dimension would be an integer ranging from 0 to 11. Using the active-reflective dimension as an example, 0 or 1 'a' responses would represent a strong preference for reflective learning, 2 or 3 a moderate preference for reflective, 4 or 5 a mild preference for reflective, 6 or 7 a mild preference for active learning, 8 or 9 a moderate preference for active, and 10 or 11 a strong preference for active. This method was used in all of the statistical analyses to be reported. (The method actually used to score the pencil-and-paper and an on-line version of the instrument subtracts the 'b' responses from the 'a' responses to obtain a score that is an odd number between -11 to +11). (Felder & Spurlin, 2005, p. 104)

The ILS learning styles dimensions are dichotomous, consisting of 11 forced-choice items for each domain with scores ranging from -11 to +11 in increments of 2 (-11, -9, -7, ... 7, 9, 11). The dimensions represent continua rather than either/or categories and scoring indicates that one's preferences may be strong, moderate, or almost nonexistent; Felder (1993) found that

preferences may change over time and may vary from one learning environment or subject to another.

Coffield et al.'s (2004) extensive review of learning style research and instruments found a general lack of design robustness. Almost all instruments were psychometrically flawed, thereby rendering the learning styles literature weak, unconvincing, and without an evidence-based foundation. Validation studies of the ILS have been ongoing from the inception of the instrument in 1991.

Reliability can be estimated through *inter-rater reliability*, i.e. whether the two raters are consistent, through *test-retest reliability*, assessing the consistency of a measure from one time to another, and through *internal consistency reliability*, assessing the consistency of results across items within a test. The internal consistency of single-dimensional additive scales such as in the Felder Model, can be tested using Cronbach's alpha, a coefficient assessing how well a set of items on the scale measures a single "underlying construct". (Zywno, 2003, p. 2)

Felder and Spurlin (2005) have analyzed the data from various studies related to the validity and reliability of the ILS instrument. Test-retest correlation coefficients varied based on the time between test administrations but all coefficients were significant at the 0.05 level or better. Using the criterion value of 0.5 for the Cronbach's alpha, all studies analyzed were greater than the criterion value except sequential-global in one study.

Cook and Smith (2006) evaluated the validity of the ILS to determine the learning styles of medical students and residents. Test-retest reliability for the ILS was moderate to high for the active-reflective, sensing-intuitive, and visual-verbal domains. Internal consistency was moderate to high with test-retest correlations generally higher than internal consistency. Both the internal consistency and test-retest correlation were low for the sequential-global domain.

Cook and Smith's (2006) study supported the validity of the active-reflective and sensing-intuitive domains but showed that the sequential-global domain might be flawed. In 2000 Van Zwanenberg et al. found low internal reliability scores for the ILS and recommended

that it be used to allow individuals to compare the strengths of their relative learning preferences rather than offering a comparison with others. Van Zwanenberg et al.'s (2000) findings agree with those of Felder and Spurlin (2005) and recommend that ILS scores should not be used to predict academic performance or draw inferences about what a student is capable of doing.

“Learning styles reflect preferences and tendencies; they are not infallible indicators of strengths or weaknesses in either the preferred or the less preferred categories of a dimension” (Felder & Spurlin, 2005, p. 110).

### Data Collection

Permission to conduct this study was obtained from the East Tennessee State Institutional Review Board. After IRB approval was granted from ETSU and each participating institution, the directors of the DPT and PTA programs at each of the participating institutions were contacted to determine a convenient time to conduct the ILS survey with students. Study participants were asked to complete the Index of Learning Styles Questionnaire (Appendix A), Student Demographic Information Form (Appendix C), and the Participant Informed Consent Form (Appendix D).

After receiving IRB approval from each institution, each program director was contacted for permission to visit and talk with students about the study and scheduled a date and time for the visit. The researcher met with the students at each institution to inform them of the study, answer questions, and distribute the packets. Participant packets consisted of the Index of Learning Styles Questionnaire, Student Demographic Information Form, and Participant Informed Consent Form; each participant was asked to complete all packet materials. To assure anonymity no identifying information was requested or recorded. After a mutually agreed upon

time was established, the researcher traveled to each institution to distribute and collect the ILS and other materials contained in the participant packet.

### Data Analysis

Descriptive statistics and inferential statistics were calculated and reported in this study. Specifically, cross-tabulated tables with frequency counts and percentages and a series of chi square tests were used to address the research questions. Statistical significance was established using an alpha level of .05. Data were analyzed using the Statistical Package for the Social Sciences (SPSS).

### Chapter Summary

Chapter 3 describes the research design, study population, data collection procedure, data collection instrument, psychometrics of the instrument, the research questions, and corresponding null hypotheses that guided this study. Chapter 3 also describes the population, data collection instrument, psychometrics of the instrument, and data collection procedures. Chapter 4 presents the findings of the study. Chapter 5 summarizes the findings, presents the conclusions of the study, and provides recommendations for practice and future research.

## CHAPTER 4

### FINDINGS

The purpose of this study was to determine the learning styles of doctor of physical therapy (DPT) students and physical therapist assistant (PTA) students and identify any association between their learning styles. Results from this study were also used to examine the association between the demographic variables of gender and age in relation to learning style preferences. Learning styles are an important component of learning, imperative for effective team relationships within a challenging healthcare environment, and a critical component in becoming an effective lifelong learner. An investigation of the learning styles of physical therapists and physical therapist assistants is critical to prepare physical therapy students to meet academic and clinical challenges. An understanding of one's preferences for receiving and processing information will benefit the student, healthcare team, and the patient.

#### Dimension Frequencies and Percentages

The Index of Learning Styles (ILS) instrument designed by Felder and Silverman was used for this study. This instrument identified learning styles based on four dimensions (sensing and intuitive, visual and verbal, active and reflective, and sequential and global). Each dimension consisted of two bipolar entities that represented the extremes of a wide continuum.

#### Sensing-Intuitive

Table 2 shows that the majority of participants reported either a very strongly or moderately sensing learning style. There were 208 (62.8%) sensing participants, 108 (32.6%) balanced participants, and 15 (4.5%) intuitive participants. The majority (316 or 95.4%) of the participants reported to be either sensing or balanced.

Table 2

*Frequencies and Percentages for Sensing-Intuitive Dimension*

Sensing-Intuitive	<i>N</i>	%
Very Strongly Sensing	96	29.0
Moderately Sensing	112	33.8
Balanced	108	32.6
Moderately Intuitive	11	3.3
Very Strongly Intuitive	4	1.2
<i>Total</i>	<i>331</i>	<i>100.0</i>

Visual-Verbal

Table 3 shows that the majority of participants reported either a very strongly or moderately visual learning style. There were 184 (55.4%) visual participants, 133 (40.1%) balanced participants, and 15 (4.5%) verbal participants. The majority (317 or 95.5%) of the participants reported to be either visual or balanced.

Table 3

*Frequencies and Percentages for the Visual-Verbal Dimension*

Visual-Verbal	<i>N</i>	%
Very Strongly Visual	85	25.6
Moderately Visual	99	29.8
Balanced	133	40.1
Moderately Verbal	12	3.6
Very Strongly Verbal	3	0.9
<i>Total</i>	<i>332</i>	<i>100.0</i>

Active-Reflective

Table 4 shows that the majority of participants reported a balanced active-reflective learning style. There were 93 (28.0%) very strongly or moderately active participants, 187

(56.3%) balanced participants, and 52 (15.7%) reflective participants. The majority (187 or 56.3%) were balanced and 145 (43.5%) reported to be either active or reflective.

Table 4

*Frequencies and Percentages for the Active-Reflective Dimension*

Active-Reflective	<i>N</i>	%
Very Strongly Active	21	6.3
Moderately Active	72	21.7
Balanced	187	56.3
Moderately Reflective	42	12.7
Very Strongly Reflective	10	3.0
<i>Total</i>	<i>332</i>	<i>100.0</i>

Sequential-Global

Table 5 shows that the majority of participants reported a balance sequential-global learning style. There were 115 (34.7%) very strongly or moderately sequential participants, 194 (58.6%) balanced participants, and 22 (6.6%) global participants. The majority (194 or 58.6%) were balanced and 137 (41.3%) reported to be either sequential or global.

Table 5

*Frequencies and Percentages for the Sequential-Global Dimension*

Sequential-Global	<i>N</i>	%
Very Strongly Sequential	20	6.0
Moderately Sequential	95	28.7
Balanced	194	58.6
Moderately Global	16	4.8
Very Strongly Global	6	1.8
<i>Total</i>	<i>331</i>	<i>100.0</i>



### Preliminary Analysis

Preliminary analysis of the crosstabulated tables generated for the analysis of the research questions showed violations of assumptions for the chi square test. Of the 20 crosstabulated tables, 14 (70%) had violations in the assumptions of the test statistic. The violations were related to the assumption that no more than 20% of the cells in the table could have an expected frequency less than five. As a result of the high number of crosstabulated tables with at least one violation of assumptions for the chi square test, instead of using five-response categories for each learning style, the responses were then collapsed into three categories. When the learning style responses were collapsed into three categories there were no violations of assumptions for the chi square test.

### Research Questions and Analyses

Five research questions and their corresponding null hypotheses were used in this study to determine if there was a significant difference in the learning styles of DPT students and PTA students and identify associations between the learning styles of the students. This study also examined the association between demographic characteristics and learning styles. The analyses are shown here.

#### Research Question 1

RQ1: Is there a significant difference between doctor of physical therapy students and physical therapist assistant students in each of the four learning styles of the Felder-Soloman Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?

Ho<sub>1</sub>: There is no difference in the Active and Reflective Learning Style (active, balanced, and reflective) between doctor of physical therapy students and physical therapist assistant students.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the active and reflective learning style between doctor of physical therapy (DPT) students and physical therapist assistant (PTA) students. The active and reflective learning style had three levels (active, balanced, and reflective). The chi square test was not significant, Pearson's  $\chi^2(2, N = 332) = 5.62, p = .060$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the active and reflective learning style between doctor of physical therapy (DPT) students and physical therapist assistant (PTA) students. The strength of the relationship between the program of study and the active and reflective learning style as measured by Cramer's  $V(.13)$  was weak. As shown in Table 6 percentages of DPT students and PTA students were similar for both the active and balanced learning styles. The largest difference in percentages for the two groups was for the reflective learning style. Although the difference was minimal, a higher percentage of DPT students (19.4%) reported a reflective learning style than PTA students (9.9%). Figure 6 shows the bar chart for the active, balanced, and reflective learning styles by program of study.

Table 6

*Crosstabulated Table for the Active-Reflective Learning Style by Program of Study*

Active-Reflective Learning Style	Doctor of Physical Therapy		Physical Therapist Assistant	
	<i>N</i>	%	<i>N</i>	%
Active	52	25.9	41	31.3
Balanced	110	54.7	77	58.8
Reflective	39	19.4	13	9.9
<i>Total</i>	<i>201</i>	<i>100.0</i>	<i>131</i>	<i>100.0</i>

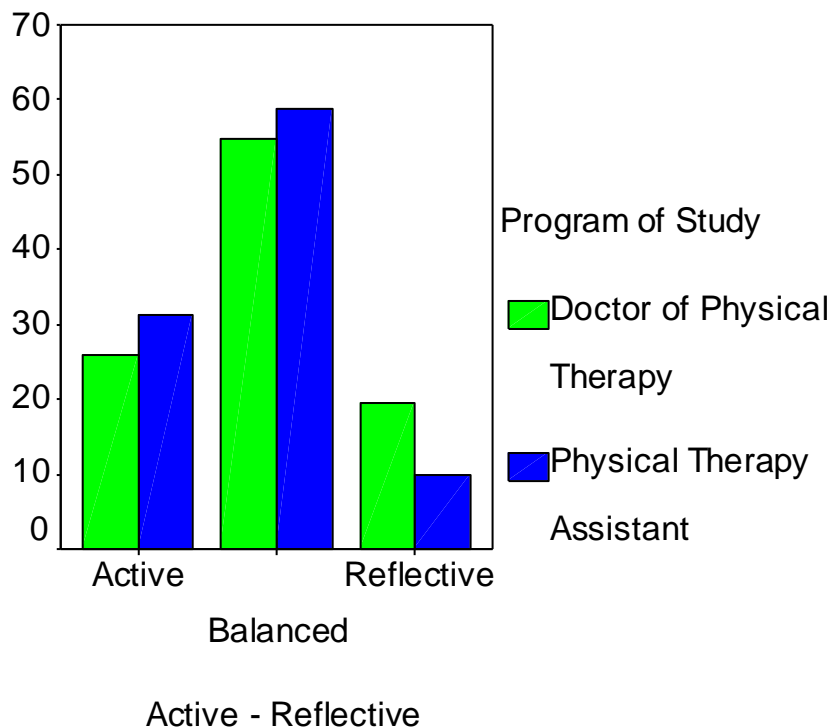


Figure 6. Bar chart for the active-reflective learning style by program of study.

Ho<sub>12</sub>: There is no difference in the Sensing and Intuitive Learning Style (sensing, balanced, and intuitive) between doctor of physical therapy students and physical therapist assistant students.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the sensing and intuitive learning style between DPT students and PTA students. The sensing and intuitive learning style had three levels (sensing, balanced, and intuitive). The chi square test was not significant, Pearson's  $\chi^2 (2, N = 331) = 3.99, p = .136$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the sensing and intuitive learning style between DPT students and PTA students. The strength of the relationship between the program of study and the sensing and intuitive learning style as measured by Cramer's  $V (.11)$  was weak. As shown in Table 7 percentages of DPT students and PTA students were similar for both the

sensing and balanced learning styles. The largest difference in the percentages for the two groups was for the sensing learning style. Although the difference was minimal, a lower percentage of DPT students (58.7%) reported a sensing learning style than PTA students (69.2%). Figure 7 shows the bar chart for the sensing, balanced, and intuitive learning styles by program of study.

Table 7

*Crosstabulated Table for the Sensing-Intuitive Learning Style by Program of Study*

Sensing-Intuitive Learning Style	Doctor of Physical Therapy		Physical Therapist Assistant	
	<i>N</i>	%	<i>N</i>	%
Sensing	118	58.7	90	69.2
Balanced	72	35.8	36	27.7
Intuitive	11	5.5	4	3.1
<i>Total</i>	<i>201</i>	<i>100.0</i>	<i>130</i>	<i>100.0</i>

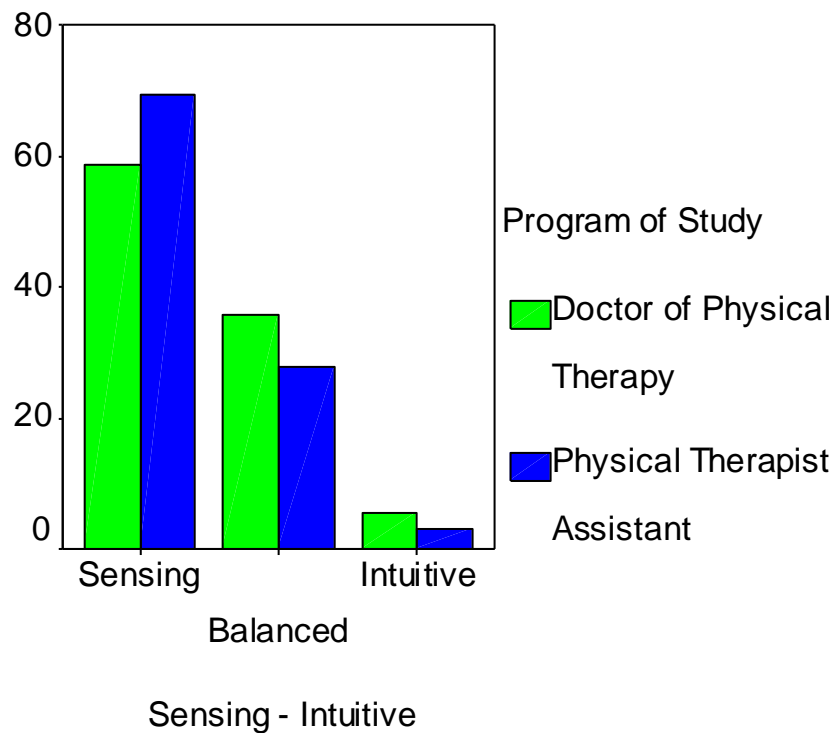


Figure 7. Bar chart for the sensing-intuitive learning style by program of study.

Ho<sub>13</sub>: There is no difference in the Visual and Verbal Learning Style (visual, balanced, and verbal) between doctor of physical therapy students and physical therapist assistant students.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the visual and verbal learning style between DPT students and PTA students. The visual and verbal learning style had three levels (visual, balanced, and verbal). The chi square test was not significant, Pearson's  $\chi^2 (2, N = 332) = 2.90, p = .235$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the visual and verbal learning style between DPT students and PTA students. The strength of the relationship between the program of study and the visual and verbal learning style as measured by Cramer's  $V (.09)$  was weak. As shown in Table 8 percentages of DPT students and PTA students were similar for both the visual and balanced learning styles. The largest difference in the percentages for the two groups was for the visual learning style. Although the difference was minimal, a higher percentage of DPT students (59.0%) reported a visual learning style than PTA students (49.6%). Figure 8 shows the bar chart for the visual, balanced, and reflective learning styles by program of study.

Table 8

*Crosstabulated Table for the Visual-Verbal Learning Style by Program of Study*

Visual-Verbal Learning Style	Doctor of Physical Therapy		Physical Therapist Assistant	
	<i>N</i>	%	<i>N</i>	%
Visual	121	59.0	63	49.6
Balanced	76	37.1	57	44.9
Verbal	8	3.9	7	5.5
<i>Total</i>	<i>205</i>	<i>100.0</i>	<i>127</i>	<i>100.0</i>

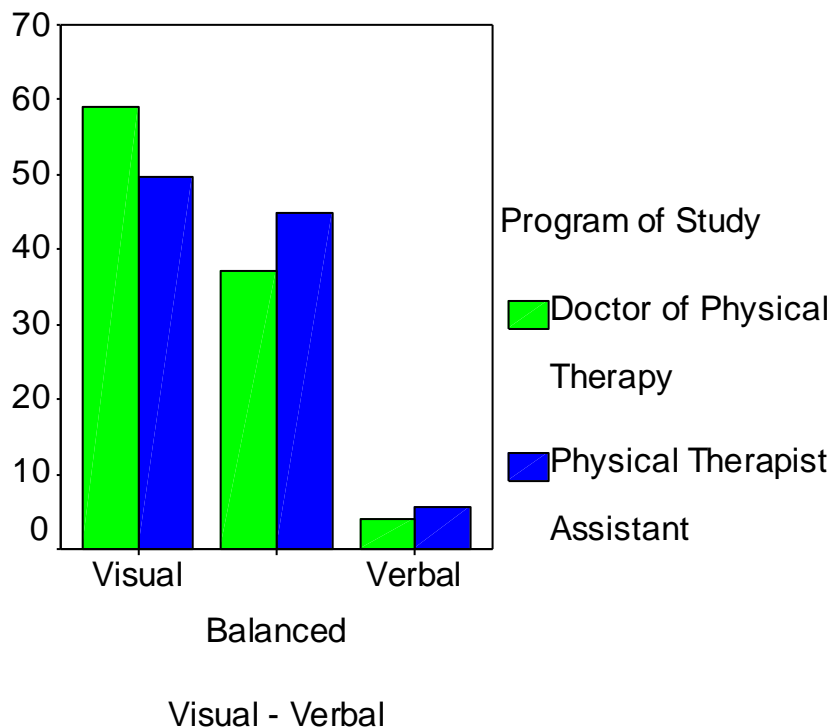


Figure 8. Bar chart for the visual-verbal learning style by program of study.

Ho<sub>14</sub>: There is no difference in the Sequential and Global Learning Style (sequential, balanced, and global) between the doctor of physical therapy students and physical therapist assistant students.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the sequential and global learning style between DPT students and PTA students. The sequential and global learning style had three levels (sequential, balanced, and global). The chi square test was not significant, Pearson’s  $\chi^2(2, N = 331) = 4.37, p = .112$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the sequential and global learning style between DPT students and PTA students. The strength of the relationship between the program of study and the sequential and global learning style as measured by Cramer’s  $V(.12)$  was weak. As shown in Table 9 percentages of DPT students and PTA students were similar for both the

sequential and balanced learning styles. The largest difference in percentages for the two groups was for the global learning style. Although the difference was minimal, a higher percentage of DPT students (8.9%) reported a global learning style than PTA students (3.1%). Figure 9 shows the bar chart for the sequential, balanced, and global learning styles by program of study.

Table 9

*Crosstabulated Table for the Sequential-Global Learning Style by Program of Study*

Sequential-Global Learning Style	Doctor of Physical Therapy		Physical Therapist Assistant	
	<i>N</i>	%	<i>N</i>	%
Sequential	67	33.0	48	37.5
Balanced	118	58.1	76	59.4
Global	18	8.9	4	3.1
<i>Total</i>	<i>203</i>	<i>100.0</i>	<i>128</i>	<i>100.0</i>

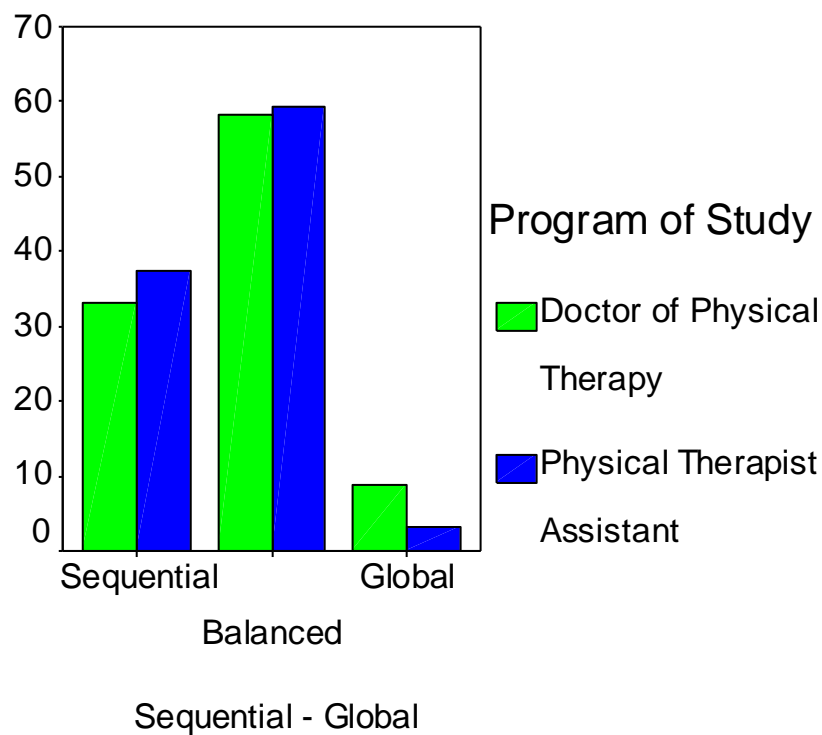


Figure 9. Bar chart for the sequential-global learning style by program of study.

## Research Question 2

RQ2: Among doctor of physical therapy students is there a significant difference between male and female students in each of the four learning styles of the Felder-Soloman Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?

Ho<sub>2</sub>: Among doctor of physical therapy students there is no difference in the Active and Reflective Learning Style (active, balanced, and reflective) between male and female students.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the active and reflective learning style among DPT students by gender. The active and reflective learning style had three levels (active, balanced, and reflective). The chi square test was not significant, Pearson's  $\chi^2 (2, N = 201) = 2.40, p = .302$ . Therefore, the null hypothesis was retained.

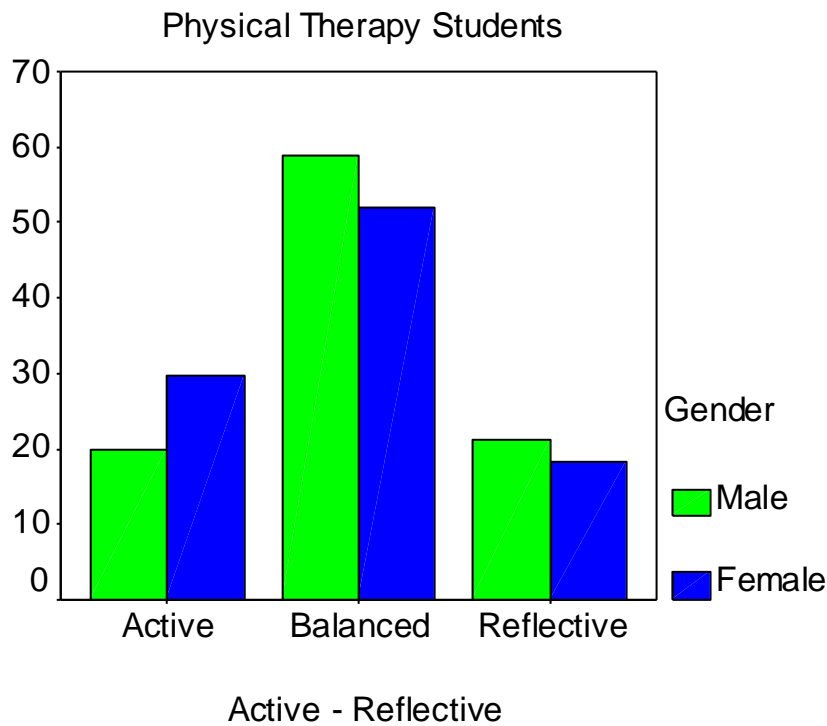
There was no statistically significant difference in the active and reflective learning style among DPT students by gender. The strength of the relationship between male and female DPT students and the active and reflective learning style as measured by Cramer's  $V (.10)$  was weak. As shown in Table 10 the highest percentage of male (58.8%) and female (52.1%) DPT students exhibited a balanced learning style. The largest difference in percentages for male and female DPT students was for the active learning style. Although the difference was minimal, a lower percentage of male DPT students (20.0%) reported an active learning style compared to that of female DPT students (29.8%). Figure 10 shows the bar chart for the active, balanced, and reflective learning styles of DPT students by gender.



Table 10

*Crosstabulated Table for the Physical Therapy Students' Active-Reflective Learning Style by Gender*

Active-Reflective Learning Style	Male		Female	
	<i>N</i>	%	<i>N</i>	%
Active	16	20.0	36	29.8
Balanced	47	58.8	63	52.1
Reflective	17	21.3	22	18.2
<i>Total</i>	<i>80</i>	<i>100.0</i>	<i>121</i>	<i>100.0</i>



*Figure 10.* Bar chart for the Doctor of Physical Therapy students' active-reflective learning style by gender.

Ho<sub>2</sub>: Among doctor of physical therapy students there is no difference in the Sensing and Intuitive Learning Style (sensing, balanced, and intuitive) between male and female students.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the sensing and intuitive learning style among DPT students by gender. The sensing and intuitive learning style had three levels (sensing, balanced, and intuitive). The chi square test was not significant, Pearson's  $\chi^2(2, N = 201) = 1.70, p = .427$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the sensing and intuitive learning style among DPT students by gender. The strength of the relationship between male and female DPT students and the sensing and reflective learning style as measured by Cramer's  $V(.09)$  was weak. As shown in Table 11 the highest percentage of male (53.8%) and female (62.0%) DPT students exhibited a sensing learning style. The largest difference in percentages for male and female DPT students was for the balanced learning style. Although the difference was minimal, a higher percentage of male DPT students (41.3%) reported a balanced learning style compared to that of female DPT students (32.2%). Figure 11 shows the bar chart for the sensing, balanced, and intuitive learning styles of DPT students by gender.

Table 11

*Crosstabulated Table for the Physical Therapy Students' Sensing-Intuitive Learning Style by Gender*

Sensing-Intuitive Learning Style	Male		Female	
	<i>N</i>	%	<i>N</i>	%
Sensing	43	53.8	75	62.0
Balanced	33	41.3	39	32.2
Intuitive	4	5.0	7	5.8
<i>Total</i>	<i>80</i>	<i>100.0</i>	<i>121</i>	<i>100.0</i>

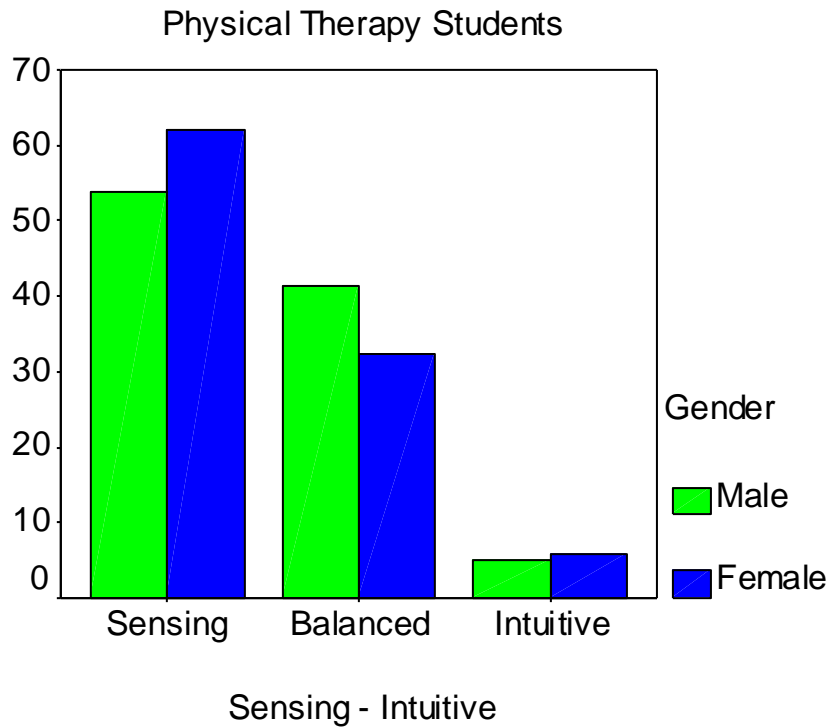


Figure 11. Bar chart for the Doctor of Physical Therapy students' sensing-intuitive learning style by gender.

Ho<sub>23</sub>: Among doctor of physical therapy students there is no difference in the Visual and Verbal Learning Style (visual, balanced, and verbal) between male and female students.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the visual and verbal learning style among DPT students by gender. The visual and verbal learning style had three levels (visual, balanced, and verbal). The 2 by 3 table showed violation of an assumption for the chi square test; more than 20% (33.3%) had an expected count of less than five. The violation was related to the small number of male DPT students ( $n = 2$ ) and female DPT students ( $n = 6$ ) who scored verbal on the visual and verbal learning style continuum. In an attempt to correct the violation, participants who scored verbal were excluded from the analysis. The resulting 2 by 2 crosstabulated table using only two levels of the learning

style (visual and balanced) showed there were no violations of the assumptions of chi square.

The chi square test was not significant, Pearson's  $\chi^2 (1, N = 197) = 2.80, p = .094$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the visual and verbal learning style among DPT students by gender. The strength of the relationship between gender and the visual and verbal learning style as measured by Phi (.12) was weak. As shown in Table 12 a higher percentage of male DPT students (68.3%) reported a visual learning style compared to that of female DPT students (56.5%). Figure 12 shows the bar chart for the visual and balanced learning styles of DPT students by gender.

Table 12

*Crosstabulated Table for the Physical Therapy Students' Visual-Verbal Learning Style by Gender*

Visual-Verbal Learning Style	Male		Female	
	<i>N</i>	%	<i>N</i>	%
Visual	56	68.3	65	56.5
Balanced	26	31.7	50	43.5
<i>Total</i>	82	100.0	115	100.0

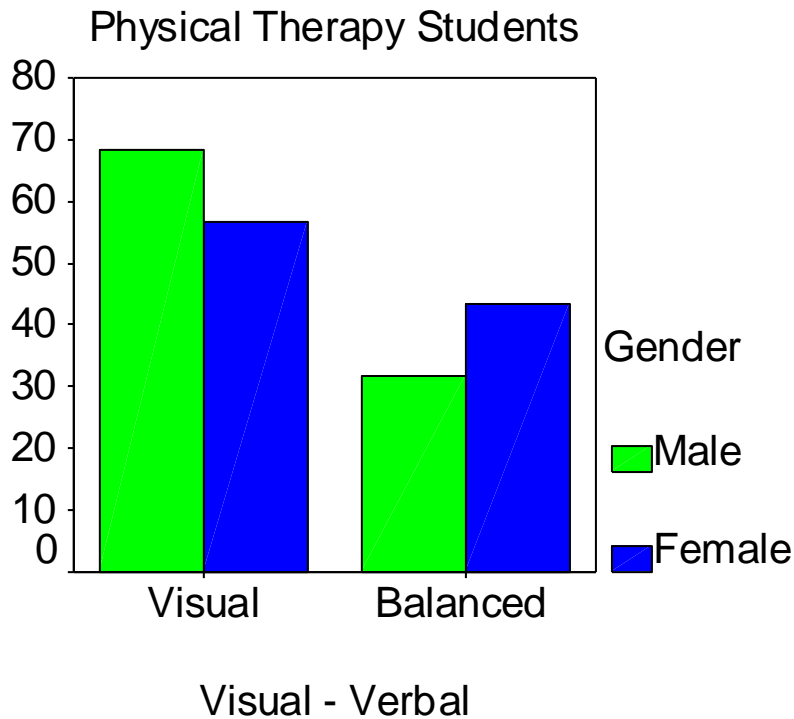


Figure 12. Bar chart for the Doctor of Physical Therapy students' visual-verbal learning style by gender.

Ho<sub>24</sub>: Among doctor of physical therapy students there is no difference in the Sequential and Global Learning Style (sequential, balanced, and global) between male and female students.

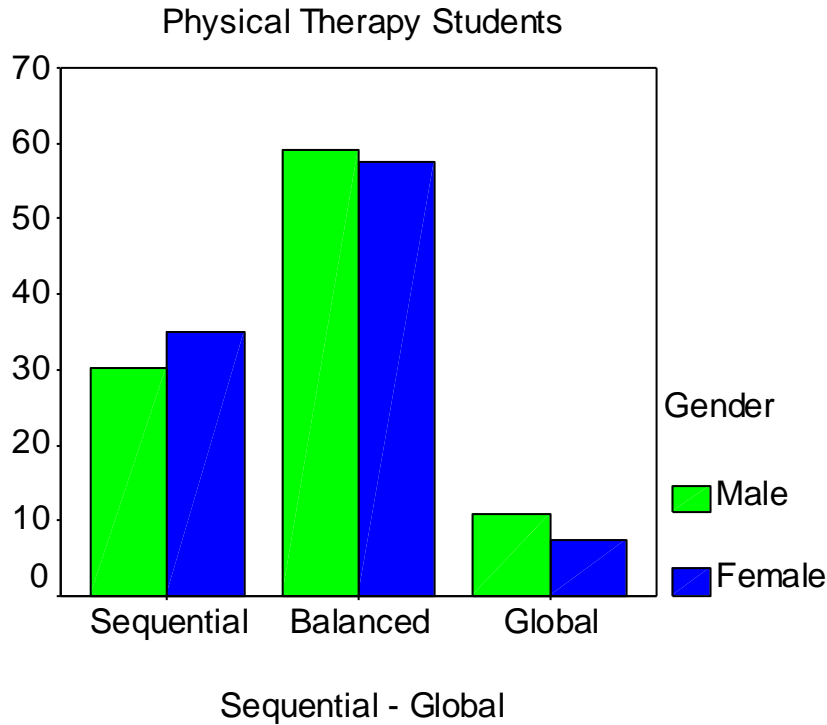
A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the sequential and global learning style among DPT students by gender. The sequential and global learning style had three levels (sequential, balanced, and global). The chi square test was not significant, Pearson's  $\chi^2(2, N = 203) = 0.99, p = .609$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the sequential and global learning style among DPT students by gender. The strength of the relationship between male and female DPT students and the sequential and global learning style as measured by Cramer's  $V$  (.07) was weak. As shown in Table 13 the highest percentage of male (59.0%) and female (57.5%) DPT students exhibited a balanced learning style. The largest difference in percentages for male and female DPT students was for the sequential learning style. Although the difference was minimal, a lower percentage of male DPT students (30.1%) reported a sequential learning style compared to that of female DPT students (35.0%). Figure 13 shows the bar chart for the sequential, balanced, and global learning styles of DPT students by gender.

Table 13

*Crosstabulated Table for the Physical Therapy Students' Sequential-Global Learning Style by Gender*

Sequential-Global Learning Style	Male		Female	
	<i>N</i>	%	<i>N</i>	%
Sequential	25	30.1	42	35.0
Balanced	49	59.0	69	57.5
Global	9	10.8	9	7.5
<i>Total</i>	83	100.0	120	100.0



*Figure 13.* Bar chart for the Doctor of Physical Therapy students' sequential-global learning style by gender.

### Research Question 3

RQ3: Among physical therapist assistant students is there a significant difference between male and female students in each of the four learning styles of the Felder-Soloman Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?

Ho3<sub>1</sub>: Among physical therapist assistant students there is no difference in the Active and Reflective Learning Style (active, balanced, and reflective) between male and female students.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the active and reflective learning style among PTA students by gender. The active and reflective learning style had three levels (active, balanced, and reflective). The chi square

test was not significant, Pearson's  $\chi^2(2, N = 131) = 4.16, p = .125$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the active and reflective learning style among PTA students by gender. The strength of the relationship between male and female PTA students and the active and reflective learning style as measured by Cramer's  $V(.18)$  was weak. As shown in Table 14 a lower percentage of male (53.2%) than female (61.9%) PTA students exhibited a balanced learning style. The largest difference in the percentages for male and female PTA students was for the reflective learning style. A higher percentage of male PTA students (17.0%) reported a reflective learning style compared to that of female PTA students (6.0%). Figure 14 shows the bar chart for the active, balanced, and reflective learning styles of PTA students by gender.

Table 14  
*Crosstabulated Table for the Physical Therapist Assistant Students' Active-Reflective Learning Style by Gender*

Active-Reflective Learning Style	Male		Female	
	<i>N</i>	%	<i>N</i>	%
Active	14	29.8	27	32.1
Balanced	25	53.2	52	61.9
Reflective	8	17.0	5	6.0
<i>Total</i>	<i>47</i>	<i>100.0</i>	<i>84</i>	<i>100.0</i>



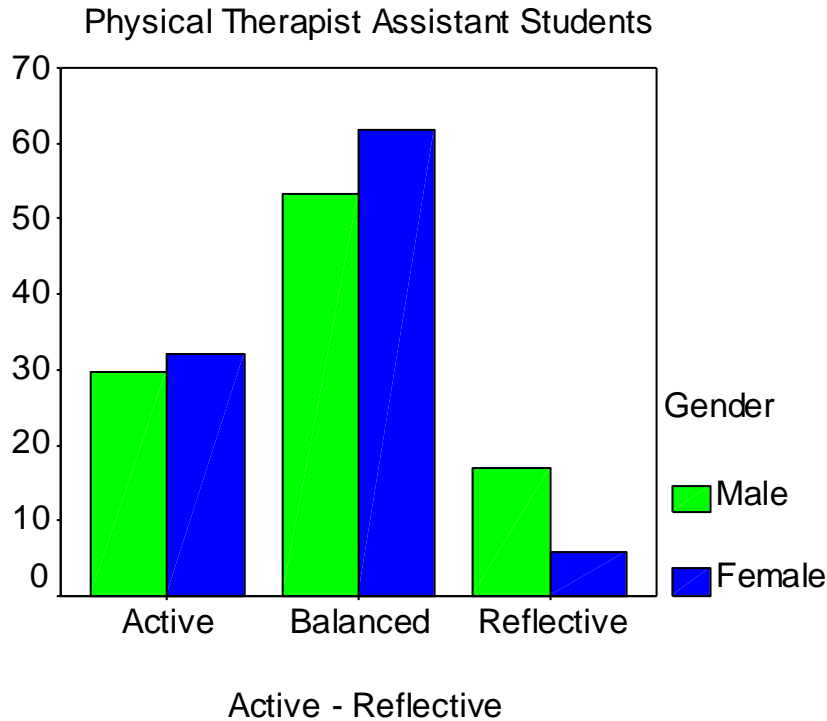


Figure 14. Bar chart for the Physical Therapist Assistant students' active-reflective learning style by gender.

Ho3<sub>2</sub>: Among physical therapist assistant students there is no difference in the Sensing and Intuitive Learning Style (sensing, balanced, and intuitive) between male and female students.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the sensing and intuitive learning style among PTA students by gender. The sensing and intuitive learning style had three levels (sensing, balanced, and intuitive). The 2 by 3 table showed violation of an assumption for the chi square test; more than 20% (33.3%) had an expected count of less than five. The violation was related to the small number of male PTA students ( $n = 2$ ) and female PTA students ( $n = 2$ ) who scored intuitive on the sensing and intuitive learning style continuum. In an attempt to correct the violation, participants who scored intuitive were excluded from the analysis. The resulting 2 by 2 crosstabulated table using only

two levels of the learning style (sensing and balanced) showed there were no violations of the assumptions of chi square. The chi square test was not significant, Pearson's  $\chi^2 (1, N = 126) = 2.91, p = .088$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the sensing and intuitive learning style among PTA students by gender. The strength of the relationship between gender and the sensing and intuitive learning style as measured by Phi (.15) was weak. As shown in Table 15 a somewhat lower percentage of male PTA students (62.2%) reported a sensing learning style compared to that of female DPT students (76.5%). Figure 15 shows the bar chart for the sensing and intuitive learning styles of DPT students by gender.

Table 15

*Crosstabulated Table for the Physical Therapist Assistant Students' Sensing-Intuitive Learning Style by Gender*

Sensing-Intuitive Learning Style	Male		Female	
	<i>N</i>	%	<i>N</i>	%
Sensing	28	62.2	62	76.5
Balanced	17	37.8	19	23.5
<i>Total</i>	<i>45</i>	<i>100.0</i>	<i>81</i>	<i>100.0</i>

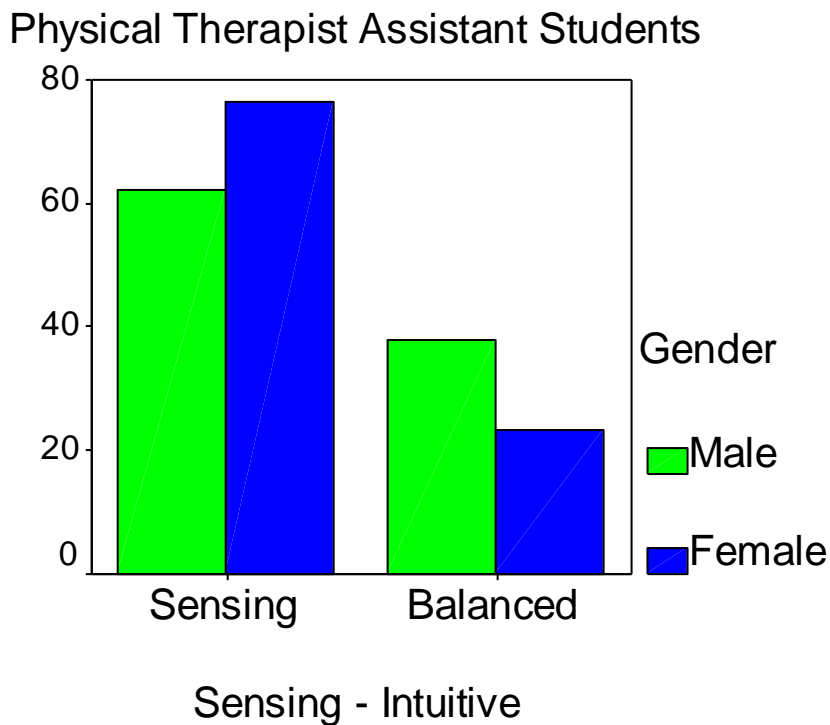


Figure 15. Bar chart for the Physical Therapist Assistant students' sensing-intuitive learning style by gender.

Ho3<sub>3</sub>: Among physical therapist assistant students there is no difference in the Visual and Verbal Learning Style (visual, balanced, and verbal) between male and female students.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the visual and verbal learning style among PTA students by gender. The visual and verbal learning style had three levels (visual, balanced, and verbal). The 2 by 3 table showed violation of an assumption for the chi square test; more than 20% (33.3%) had an expected count of less than five. The violation was related to the small number of male PTA students ( $n = 3$ ) and female PTA students ( $n = 4$ ) who scored verbal on the visual and verbal learning style continuum. In an attempt to correct the violation, participants who scored verbal were excluded from the analysis. The resulting 2 by 2 crosstabulated table using only two levels of the learning

style (visual and balanced) showed there were no violations of the assumptions of chi square.

The chi square test was not significant, Pearson's  $\chi^2 (1, N = 120) = 1.85, p = .174$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the visual and verbal learning style among PTA students by gender. The strength of the relationship between gender and the visual and balanced learning styles as measured by Phi (.12) was weak. As shown in Table 16 a somewhat lower percentage of male PTA students (43.9%) reported a visual learning style compared to that of female PTA students (57.0%). Figure 16 shows the bar chart for the visual and balanced learning styles of PTA students by gender.

Table 16

*Crosstabulated Table for the Physical Therapist Assistant Students' Visual-Verbal Learning Style by Gender*

Visual-Verbal Learning Style	Male		Female	
	<i>N</i>	%	<i>N</i>	%
Visual	18	43.9	45	57.0
Balanced	23	56.1	34	43.0
<i>Total</i>	<i>41</i>	<i>100.0</i>	<i>79</i>	<i>100.0</i>

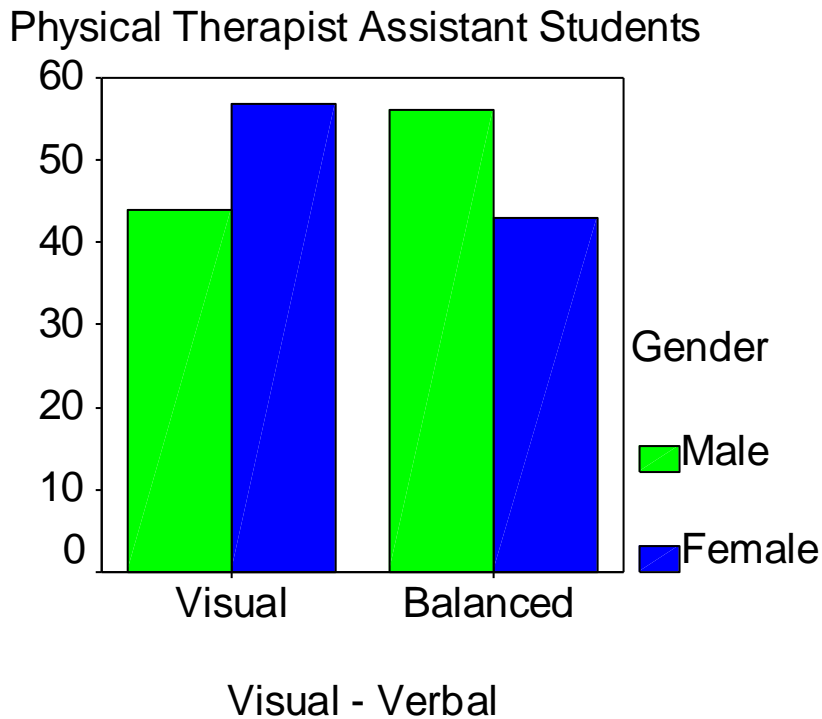


Figure 16. Bar chart for the Physical Therapist Assistant students' visual-verbal learning style by gender.

Ho3<sub>4</sub>: Among physical therapist assistant students there is no difference in the Sequential and Global Learning Style (sequential, balanced, and global) between male and female students.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the sequential and global learning style among PTA students by gender. The sequential and global learning style had three levels (sequential, balanced, and global). The 2 by 3 table showed violation of an assumption for the chi square test; more than 20% (33.3%) had an expected count of less than five. The violation was related to the small number of male PTA students ( $n = 3$ ) and female PTA students ( $n = 1$ ) who scored global on the sequential and global learning style continuum. In an attempt to correct the violation, participants who scored global were excluded from the analysis. The resulting 2 by 2 crosstabulated table using only two levels

of the learning style (sequential and balanced) showed there were no violations of the assumptions of chi square. The chi square test was not significant, Pearson's  $\chi^2 (1, N = 124) = 1.20, p = .158$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the sequential and global learning style among PTA students by gender. The strength of the relationship between gender and the sequential and balanced learning style as measured by Phi (.13) was weak. As shown in Table 17 a somewhat lower percentage of male PTA students (30.2%) reported a sequential learning style compared to that of female PTA students (43.2%). Figure 17 shows the bar chart for the sequential and balanced learning styles of PTA students by gender.

Table 17

*Crosstabulated Table for the Physical Therapist Assistant Students' Sequential-Global Learning Style by Gender*

Sequential-Global Learning Style	Male		Female	
	<i>N</i>	%	<i>N</i>	%
Sequential	13	30.2	35	43.2
Balanced	30	69.8	46	56.8
<i>Total</i>	<i>43</i>	<i>100.0</i>	<i>81</i>	<i>100.0</i>

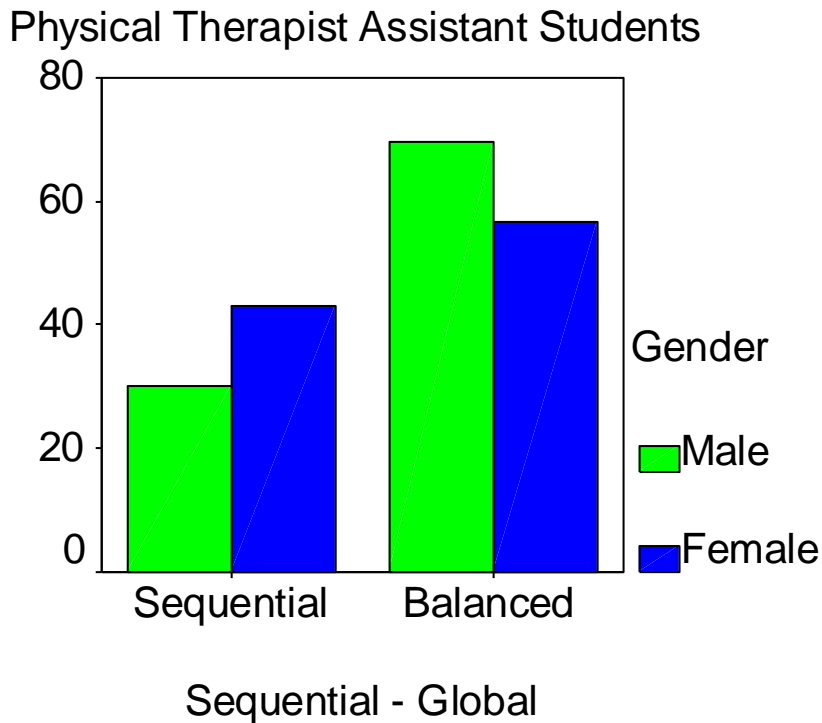


Figure 17. Bar chart for the Physical Therapist Assistant students' sequential-global learning style by gender.

#### Research Question 4

RQ4: Among doctor of physical therapy students is there a significant difference among age groups in each of the four learning styles of the Felder-Soloman Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?

H<sub>04</sub>: Among doctor of physical therapy students there is no difference in the Active and Reflective Learning Style (active, balanced, and reflective) based on age.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the active and reflective learning style among DPT students by age (24 and younger or 25 and older). The active and reflective learning style had three levels (active, balanced, and

reflective). The chi square test was not significant, Pearson's  $\chi^2 (2, N = 201) = 2.70, p = .260$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the active and reflective learning style among DPT students by age. The strength of the relationship between the age of DPT students and the active and reflective learning style as measured by Cramer's  $V (.12)$  was weak. As shown in Table 18 the highest percentage of DPT students age 24 and younger (50.9%) and DPT students age 25 and older (59.1%) exhibited a balanced learning style. The largest difference in the percentage for DPT students by age was for the active learning style. Although the difference was minimal, a higher percentage of DPT students age 24 and younger (30.6%) reported an active learning style compared to that of DPT students age 25 and older (20.4%). Figure 18 shows the bar chart for the active, balanced, and reflective learning styles of DPT students by age.

Table 18

*Crosstabulated Table for the Physical Therapy Students' Active-Reflective Learning Style by Age*

Active-Reflective Learning Style	Age 24 and Younger		Age 25 and Older	
	<i>N</i>	%	<i>N</i>	%
Active	33	30.6	19	20.4
Balanced	55	50.9	55	59.1
Reflective	20	18.5	19	20.4
<i>Total</i>	<i>108</i>	<i>100.0</i>	<i>93</i>	<i>100.0</i>



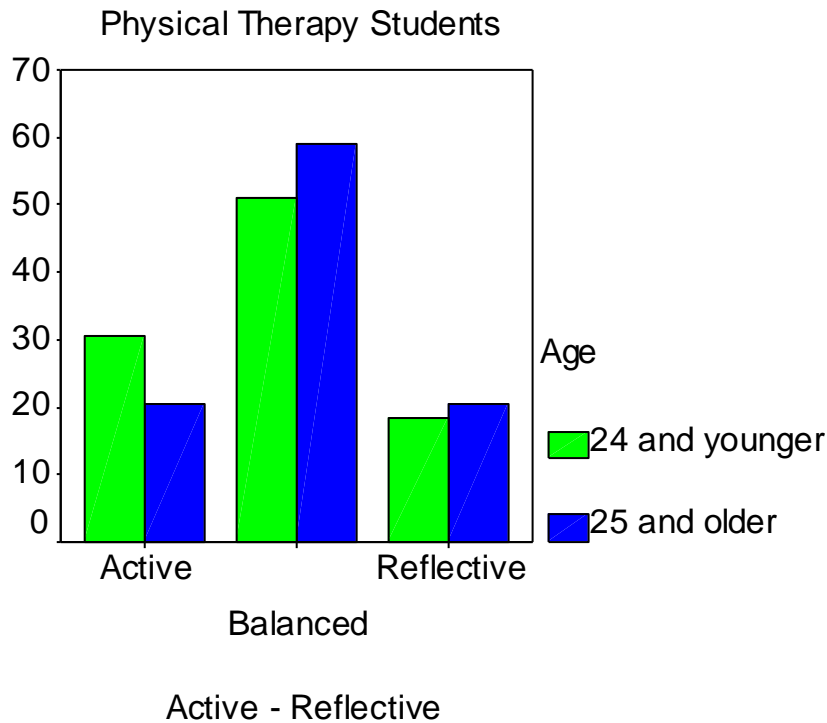


Figure 18. Bar chart for the Doctor of Physical Therapy students' active-reflective learning style by age.

Ho4<sub>2</sub>: Among doctor of physical therapy students there is no difference in the Sensing and Intuitive Learning Style (sensing, balanced, and intuitive) based on age.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the sensing and intuitive learning style among DPT students by age (24 and younger or 25 and older). The sensing and intuitive learning style had three levels (sensing, balanced, and intuitive). The chi square test was not significant, Pearson's  $\chi^2(2, N = 201) = 2.11$ ,  $p = .348$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the sensing and intuitive learning style among DPT students by age. The strength of the relationship between the age of DPT students and the sensing and intuitive learning style as measured by Cramer's  $V(.10)$  was weak. As shown in Table 19 the highest percentage of DPT students age 24 and younger (63.3%) and DPT

students age 25 and older (53.3%) exhibited a sensing learning style. The largest difference in the percentage for DPT students by age was for the sensing learning style. Although the difference was minimal, a higher percentage of DPT students age 24 and younger (63.3%) reported a sensing learning style compared to that of DPT students age 25 and older (53.3%). Figure 19, shows the bar chart for the sensing, balanced, and intuitive learning styles of DPT students by age.

Table 19

*Crosstabulated Table for the Physical Therapy Students' Sensing-Intuitive Learning Style by Age*

Sensing-Intuitive Learning Style	Age 24 and Younger		Age 25 and Older	
	<i>N</i>	%	<i>N</i>	%
Sensing	69	63.3	49	53.3
Balanced	35	32.1	37	40.2
Intuitive	5	4.6	6	6.5
<i>Total</i>	<i>109</i>	<i>100.0</i>	<i>92</i>	<i>100.0</i>

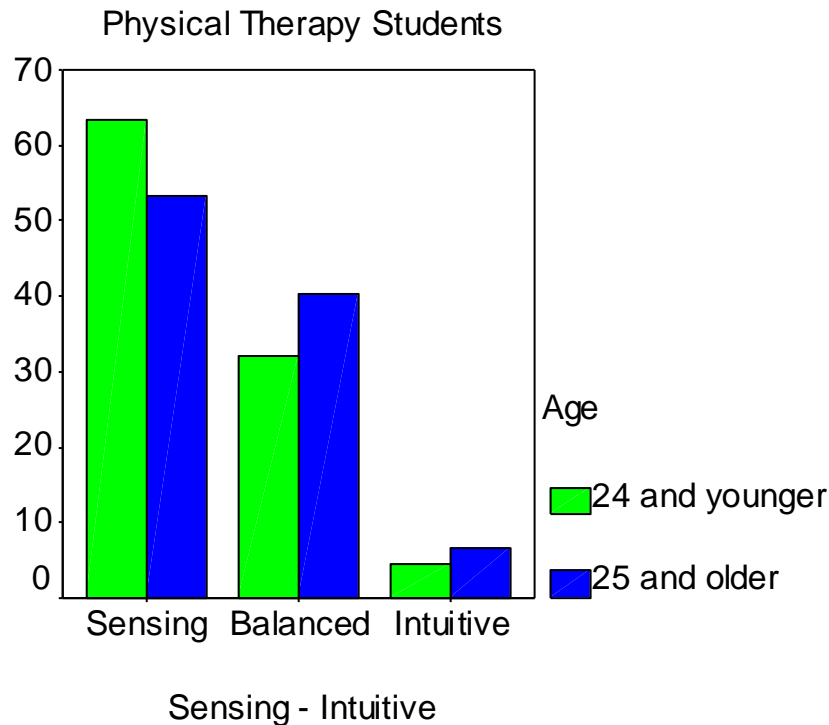


Figure 19. Bar chart for the Doctor of Physical Therapy students' sensing-intuitive learning style by age.

Ho<sub>43</sub>: Among doctor of physical therapy students there is no difference in the Visual and Verbal Learning Style (visual, balanced, and verbal) based on age.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the visual and verbal learning style among DPT students by age (24 and younger or 25 and older). The visual and verbal learning style had three levels (visual, balanced, and verbal). The 2 by 3 table showed violation of an assumption for the chi square test; more than 20% (33.3%) had an expected count of less than five. The violation was related to the small number of DPT students ( $n = 4$ ) age 24 and younger and DPT students ( $n = 4$ ) age 25 and older that scored verbal on the visual and verbal learning style continuum. In an attempt to correct the violation, participants who scored verbal were excluded from the analysis. The resulting 2 by 2 crosstabulated table using only two levels of the learning style (visual and balanced) showed

there were no violations of the assumptions of chi square. The chi square test was not significant, Pearson's  $\chi^2 (1, N = 197) = 0.38, p = .536$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the visual and verbal learning style among DPT students by age. The strength of the relationship between age and the visual and balanced learning style as measured by Phi (.04) was weak. As shown in Table 20 there was very little difference between DPT students age 24 and younger and DPT students age 25 and older and the visual and balanced learning styles. Figure 20 shows the bar chart for the visual and balanced learning styles of DPT students by age.

Table 20

*Crosstabulated Table for the Physical Therapy Students' Visual-Verbal Learning Style by Age*

Visual-Verbal Learning Style	Age 24 and Younger		Age 25 and Older	
	<i>N</i>	%	<i>N</i>	%
Visual	63	59.4	58	63.7
Balanced	43	40.6	33	36.3
<i>Total</i>	<i>106</i>	<i>100.0</i>	<i>91</i>	<i>100.0</i>

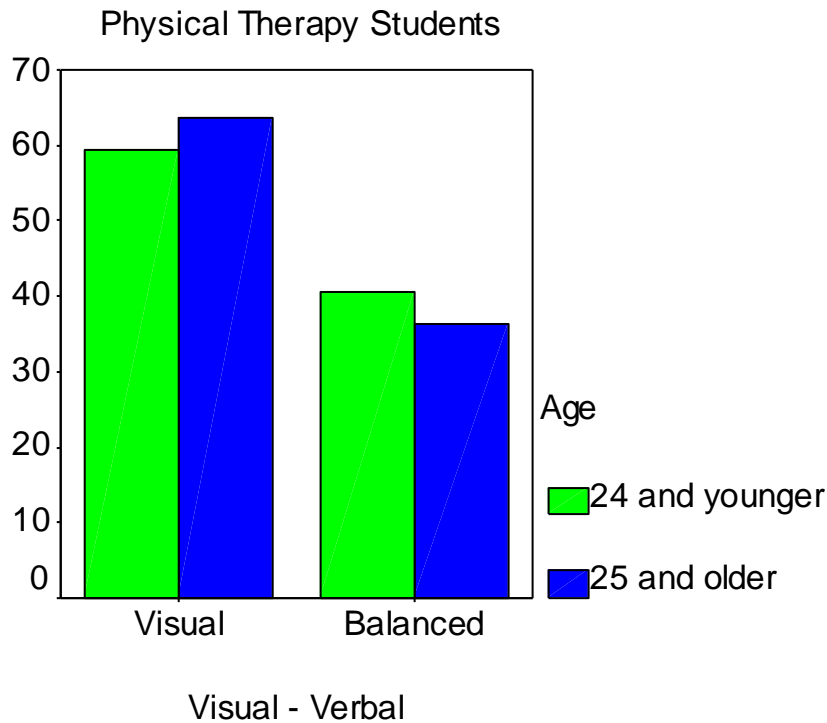


Figure 20. Bar chart for the Doctor of Physical Therapy students' visual-verbal learning style by age.

Ho4<sub>4</sub>: Among doctor of physical therapy students there is no difference in the Sequential and Global Learning Style (sequential, balanced, and global) based on age.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the sequential and global learning style among DPT students by age (24 and younger or 25 and older). The sequential and global learning style had three levels (sequential, balanced, and global). The chi square test was not significant, Pearson's  $\chi^2(2, N = 203) = 1.20, p = .552$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the sequential and global learning style among DPT students by age. The strength of the relationship between the age of DPT students and the sequential and global learning style as measured by Cramer's  $V(.08)$  was weak. As shown in Table 21 the highest percentage of DPT students age 24 and younger (61.1%) and DPT

students age 25 and older (54.7%) reported a balanced learning style. The largest difference in the percentage for DPT students by age was for the sequential learning style. A higher percentage of DPT students age 24 and younger (9.3%) reported a global learning style compared to that of DPT students age 25 and older (8.4%). Figure 21 shows the bar chart for the sequential, balanced, and global learning styles of DPT students by age.

Table 21

*Crosstabulated Table for the Physical Therapy Students' Sequential-Global Learning Style by Age*

Sequential-Global Learning Style	Age 24 and Younger		Age 25 and Older	
	<i>N</i>	%	<i>N</i>	%
Sequential	32	29.6	35	36.8
Balanced	66	61.1	52	54.7
Global	10	9.3	8	8.4
<i>Total</i>	<i>108</i>	<i>100.0</i>	<i>95</i>	<i>100.0</i>

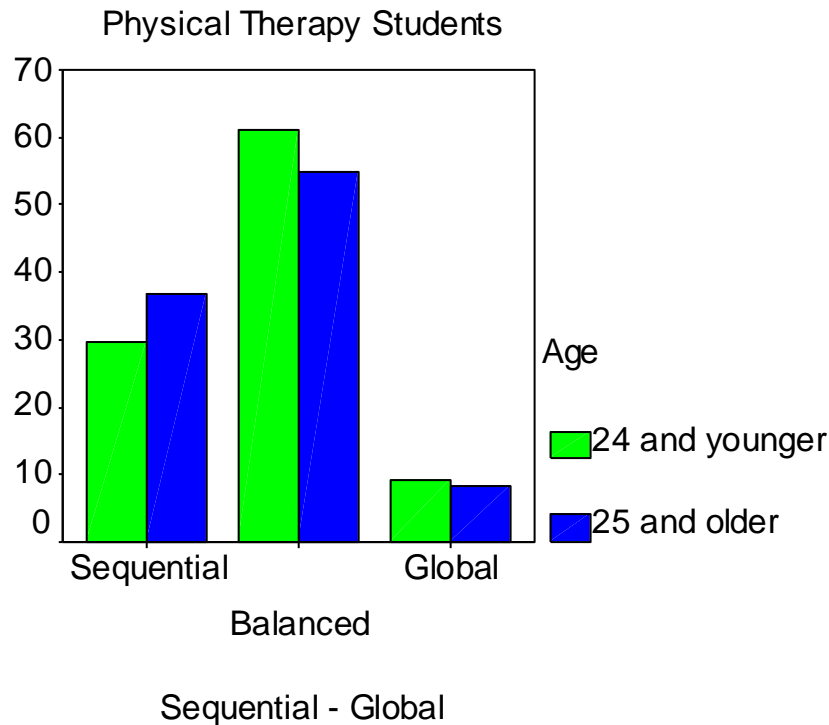


Figure 21. Bar chart for the Doctor of Physical Therapy students' sequential-global learning style by age.

#### Research Question 5

RQ5: Among physical therapist assistant students is there a significant difference among age groups in each of the four learning styles of the Felder-Soloman Learning Styles Inventory: Active and Reflective learners, Sensing and Intuitive learners, Visual and Verbal learners, and Sequential and Global learners?

Ho5<sub>1</sub>: Among physical therapist assistant students there is no difference in the Active and Reflective Learning Style (active, balanced, and reflective) based on age.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the active and reflective learning style among PTA students by age (24 and younger or 25 and older). The active and reflective learning style had three levels (active, balanced, and

reflective). The chi square test was significant, Pearson's  $\chi^2 (2, N = 131) = 7.94, p = .019$ .

Therefore, the null hypothesis was rejected.

There was a statistically significant difference in the active and reflective learning style among PTA students by age. The strength of the relationship between the age of PTA students and the active and reflective learning style as measured by Cramer's  $V (.25)$  showed a definite but weak relationship. As shown in Table 22 the highest percentage of PTA students age 24 and younger (53.2%) and PTA students age 25 and older (63.8%) exhibited a balanced learning style. The largest difference in the percentage for PTA students by age was for the active learning style. A higher percentage of PTA students age 24 and younger (41.9%) reported an active learning style compared to that of PTA students age 25 and older (21.7%). Figure 22 shows the bar chart for the active, balanced, and reflective learning styles of PTA students by age.

Table 22

*Crosstabulated Table for the Physical Therapist Assistant Students' Active-Reflective Learning Style by Age*

Active-Reflective Learning Style	Age 24 and Younger		Age 25 and Older	
	<i>N</i>	%	<i>N</i>	%
Active	26	41.9	15	21.7
Balanced	33	53.2	44	63.8
Reflective	3	4.8	10	14.5
<i>Total</i>	<i>62</i>	<i>100.0</i>	<i>69</i>	<i>100.0</i>



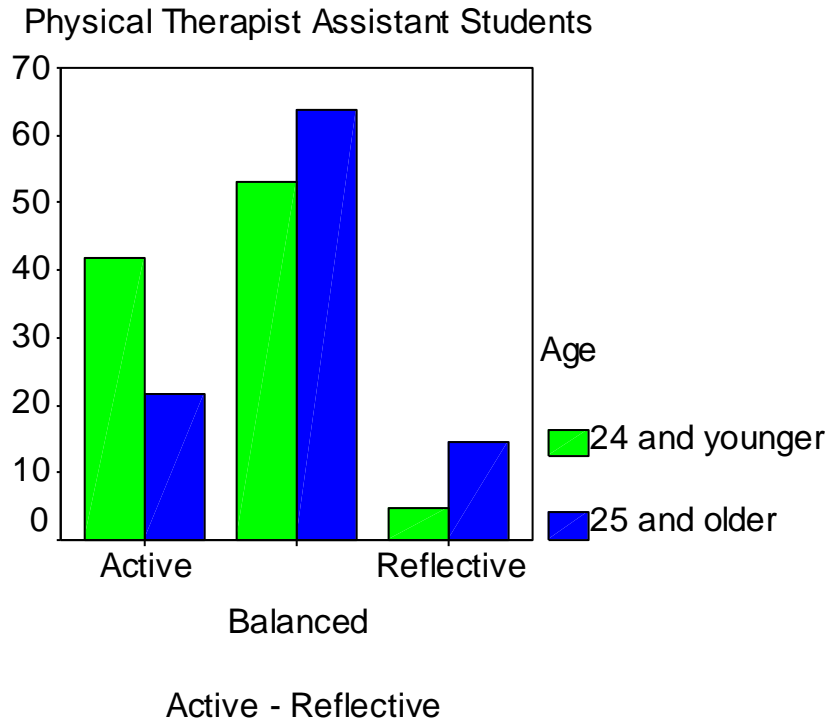


Figure 22. Bar chart for the Physical Therapist Assistant students' active-reflective learning style by age.

Ho<sub>5</sub><sub>2</sub>: Among physical therapist assistant students there is no difference in the Sensing and Intuitive Learning Style (sensing, balanced, and intuitive) based on age.

A crosstabulated table and chi square test were used to evaluate if there was a difference in the sensing and intuitive learning style among PTA students by age (24 and younger or 25 and older). The sensing and intuitive learning style had three levels (sensing, balanced, and intuitive). The 2 by 3 table showed violation of an assumption for the chi square test; more than 20% (33.3%) had an expected count of less than five. The violation was related to the small number of PTA students ( $n = 2$ ) age 24 and younger and PTA students ( $n = 2$ ) age 25 and older who scored intuitive on the sensing and intuitive learning style continuum. In an attempt to correct the violation, participants who scored intuitive were excluded from the analysis. The resulting 2 by 2 crosstabulated table using only two levels of the learning style (sensing and balanced) showed

there were no violations of the assumptions of chi square. The chi square test was not significant, Pearson's  $\chi^2 (1, N = 126) = 0.387, p = .534$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the sensing and intuitive learning style among PTA students by age. The strength of the relationship between age and the sensing and balanced learning style as measured by Phi (.06) was weak. As shown in Table 23 a slightly higher percentage of PTA students age 24 and younger (74.1%) reported a sensing learning style compared to PTA students age 25 and older (69.1%). Figure 23 shows the bar chart for the sensing and balanced learning styles of PTA students by age.

Table 23

*Crosstabulated Table for the Physical Therapist Assistant Students' Sensing-Intuitive Learning Style by Age*

Sensing-Intuitive Learning Style	Age 24 and Younger		Age 25 and Older	
	<i>N</i>	%	<i>N</i>	%
Sensing	43	74.1	47	69.1
Balanced	15	25.9	21	30.9
<i>Total</i>	<i>58</i>	<i>100.0</i>	<i>68</i>	<i>100.0</i>

## Physical Therapist Assistant Students

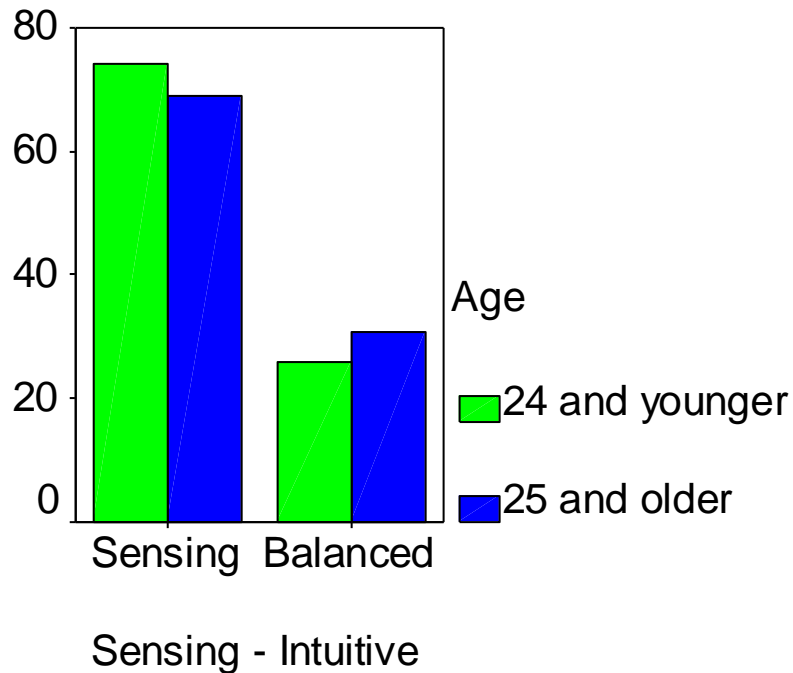


Figure 23. Bar chart for the Physical Therapist Assistant students' sensing-intuitive learning style by age.

Ho5<sub>3</sub>: Among physical therapist assistant students there is no difference in the Visual and Verbal Learning Style (visual, balanced, and verbal) based on age.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the visual and verbal learning style among PTA students by age (24 and younger or 25 and older). The visual and verbal learning style had three levels (visual, balanced, and verbal). The 2 by 3 table showed violation of an assumption for the chi square test; more than 20% (33.3%) had an expected count of less than five. The violation was related to the small number of PTA students ( $n = 3$ ) age 24 and younger and PTA students ( $n = 4$ ) age 25 and older that scored verbal on the visual and verbal learning style continuum. In an attempt to correct the violation, participants who scored verbal were excluded from the analysis. The resulting 2 by 2 crosstabulated table using only two levels of the learning style (visual and balanced) showed

there were no violations of the assumptions of chi square. The chi square test was not significant, Pearson's  $\chi^2 (1, N = 120) = < .01, p = .978$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the visual and verbal learning style among PTA students by age. There was virtually no relationship between age and the visual and balanced learning style as measured by Phi (<.01). As shown in Table 24 almost equal percentages of PTA students age 24 and younger (52.6%) and PTA students age 25 and older (52.4%) reported a visual learning style. Figure 24 shows the bar chart for the visual and balanced learning styles of PTA students by age.

Table 24

*Crosstabulated Table for the Physical Therapist Assistant Students' Visual-Verbal Learning Style by Age*

Visual-Verbal Learning Style	Age 24 and Younger		Age 25 and Older	
	<i>N</i>	%	<i>N</i>	%
Visual	30	52.6	33	52.4
Balanced	27	47.4	30	47.6
<i>Total</i>	<i>57</i>	<i>100.0</i>	<i>63</i>	<i>100.0</i>

## Physical Therapist Assistant Students

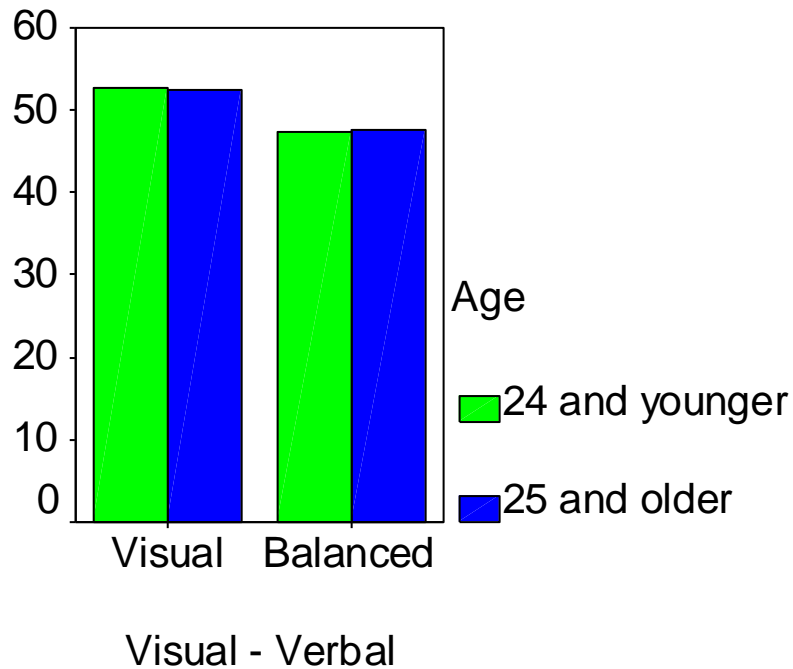


Figure 24. Bar chart for the Physical Therapist Assistant students' visual-verbal learning style by age.

Ho5<sub>4</sub>: Among physical therapist assistant students there is no difference in the Sequential and Global Learning Style (sequential, balanced, and global) based on age.

A 2 by 3 crosstabulated table and chi square test were used to evaluate if there was a difference in the sequential and global learning style among PTA students by age (24 and younger or 25 and older). The sequential and global learning style had three levels (sequential, balanced, and global). The 2 by 3 table showed violation of an assumption for the chi square test; more than 20% (33.3%) had an expected count of less than five. The violation was related to the small number of PTA students ( $n = 2$ ) age 24 and younger and PTA students ( $n = 2$ ) age 25 and older who scored global on the sequential and global learning style continuum. In an attempt to correct the violation, participants who scored global were excluded from the analysis. The

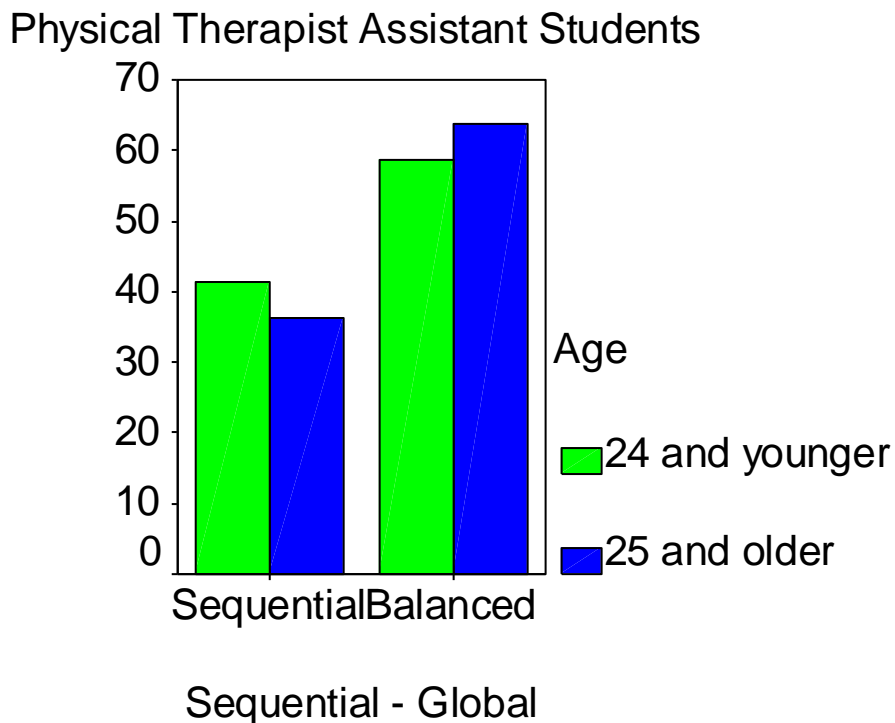
resulting 2 by 2 crosstabulated table using only two levels of the learning style (sequential and balanced) showed there were no violations of the assumptions of chi square. The chi square test was not significant, Pearson's  $\chi^2 (1, N = 124) = 0.33, p = .567$ . Therefore, the null hypothesis was retained.

There was no statistically significant difference in the sequential and global learning style among PTA students by age. The strength of the relationship between age and the sequential and balanced learning style as measured by Phi (.05) was weak. As shown in Table 25 there was very little difference between among PTA students by age for the sequential and global learning style. Figure 25 shows the bar chart for the sequential and balanced learning styles of PTA students by age.

Table 25

*Crosstabulated Table for the Physical Therapist Assistant Students' Sequential-Global Learning Style by Age*

Sequential-Global Learning Style	Age 24 and Younger		Age 25 and Older	
	<i>N</i>	%	<i>N</i>	%
Sequential	24	41.4	24	36.4
Balanced	34	58.6	42	63.6
<i>Total</i>	58	100.0	66	100.0



*Figure 25.* Bar chart for the Physical Therapist Assistant students' sequential-global learning style by age.

#### Chapter Summary

Chapter 4 presented the statistical analyses of data collected for the study. Data were collected from doctor of physical therapy (DPT) students from two universities and physical therapist assistant (PTA) students at three community colleges. Data were analyzed using a crosstabulated table and chi square test to evaluate significant differences in the four learning style dimensions by program of study, gender, and age. Of the 20 null hypotheses evaluated, only one was rejected (Ho5<sub>1</sub>: There is no difference in the active-reflective learning style among PTA students by age). Overall, the study demonstrated no significant difference between the learning styles of DPT and PTA students. Chapter 5 includes a summary of the research findings, conclusions of the study, and recommendations for practice and recommendations for future research.

## CHAPTER 5

### SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter contains a summary of the findings from the study on the learning styles of doctor of physical therapy (DPT) students and physical therapist assistant (PTA) students. The purpose of this study was to determine the learning styles of DPT and PTA students and identify any association between their learning styles. Results from this study were also used to examine the association between the demographic variables of gender and age in relation to learning style preferences. An awareness of learning styles is important to learning and teaching, imperative for effective team relationships within a challenging healthcare environment, and a critical component in becoming an effective lifelong learner. Kolb (2015) links an awareness of one's learning style to survival. It is important to understand how we learn best because an understanding of one's unique learning preferences can increase learning effectiveness. Learning is becoming an occupation for all of us as more time and energy is spent staying abreast of events and keeping skills current. The learner must manage their learning to survive in this world of rapid change and exponential growth of knowledge.

#### Summary of Findings

Chapter 1 introduced the purpose of this study, its significance, limitations, and the research questions that guided the study. Chapter 2 outlined a review of the relevant literature. Chapter 3 outlined the research methodology, research design, population, data collection, and data analysis methods. Chapter 4 presented the findings and statistical analyses of data collected for the study. Chapter 5 summarizes the findings, conclusions, and recommendations. The statistical analyses reported in this study were based on five research questions and their corresponding four null hypotheses for each research question. Crosstabulated tables with



frequency counts and percentages and chi square tests were used to address the research questions and null hypotheses. Statistical significance was established using an alpha level of .05. An understanding of the Felder-Silverman learning style model is important to fully understand the findings of this study. The Felder-Silverman learning style model assesses a learning style preference with respect to four learning style dimensions: sensing-intuitive, visual-verbal, active-reflective, and sequential-global. Felder and Silverman (1988, 1993), developed a model that defined a student's learning style using the answers to four questions:

1. Why type of information does the student preferentially perceive: *sensory* (sights, sounds, physical sensations) or *intuitive* (memories, thoughts, insights)?... This scale is identical to the sensing-intuitive scale of the Myers-Briggs Type Indicator.
2. What type of sensory information is most effectively perceived: *visual* (pictures, diagrams, flow charts, demonstrations) or *verbal* (written and spoken explanations)?
3. How does the student prefer to process information: *actively* (through engagement in physical activity or discussion) or *reflectively* (through introspection)? This scale is identical to the active-reflective scale of the Kolb model...
4. How does the student characteristically progress toward understanding: *sequentially* (in a logical progression of incremental steps) or *globally* (in large "big picture" jumps)? (Felder & Brent, 2005, p. 60)

Data were collected from doctor of physical therapy (DPT) students from two universities and physical therapist assistant (PTA) students at three community colleges. Data were analyzed using crosstabulated tables and chi square tests to evaluate for significant differences in the four learning style dimensions based on program of study, gender, and age. Of the 20 null hypotheses evaluated, only one was rejected ( $H_{o5_1}$ : Among physical therapist assistant students, there is no difference in the Active and Reflective Learning Style (active, balanced, and reflective) based on age). Among PTA students, 41.9% of those age 24 and younger reported an active learning style compared to 21.7% of PTA students age 25 and older. There were no other findings that were of statistical or practical significance.

Although not subjected to statistical testing, univariate descriptive statistics for each of the four learning style dimensions provided insight into the learning styles of students in physical therapy programs regardless of the type of program, gender, or age of students in each program:

1. On the active-reflective dimension the majority of students (56.3%) were balanced. When combined with students who scored active on the continuum, 84.3% scored either active or balanced on this continuum. Almost 16% scored reflective on the continuum.
2. On the sensing-intuitive dimension the majority of students (62.8%) were sensing. When combined with students who were balanced, 95.5% were either sensing or balanced; a small percentage (4.5%) of students were intuitive.
3. On the visual-verbal dimension the majority of students (55.4%) were visual. Almost 96% were either visual or balanced on this learning style continuum; a small percentage (4.5%) of students were verbal.
4. On the sequential-global dimension the majority of students (58.6%) were balanced. When combined with students who were sequential, 93.4% were either sequential or balanced; a small percentage (6.6%) of students were global.

There was no difference in the learning styles of the DPT students and the PTA students. Of interest, although not statistically significant, was the highest percent difference between the DPT students and the PTA students were the sensing-intuitive and visual-verbal dimensions. Results of the study revealed that 69% of the PTA students were sensing [practical, oriented toward facts and details, and concrete thinker (Felder & Silverman, 1988)] and 58.7% of the DPT students were sensing. In contrast 45.3% of all students were intuitive [innovative, creative, prefer principles and theories, and abstract thinker (Felder & Silverman, 1988)]. The next highest percent difference between DPT students and PTA students was the visual-verbal dimension;

59% of the DPT students were visual [prefer pictures, diagrams, flow charts, films, and demonstrations (Felder & Silverman, 1988)] and 49.6% of the PTA students were visual. In contrast 45.2% of all students were verbal [prefer written and spoken explanations (Felder & Spurlin, 2005)].

A statistically significant difference was found in the active-reflective learning style dimension among PTA students based on age. Among PTA students 41.9% of students age 24 and younger reported an active learning style compared to 21.7% of PTA students age 25 and older. However, among PTA students age 24 and younger 53.2% were balanced and for PTA students age 25 and older 63.8% were balanced on the active-reflective learning style dimension. There was a high percentage (74.1%) of PTA students age 24 and younger and 69.1% age 25 and older who were sensing on the sensing-intuitive learning style dimension. A slightly higher percentage of PTA students (52.6%) age 24 and younger and 52.4% age 25 and older were visual on the visual-verbal learning style dimension. The sequential-global learning style dimension was balanced among PTA students based on age.

A statistically significant difference was not found among DPT students across any learning style dimension based on age. Slightly higher percentages were found for balanced on the active-reflective and sequential-global learning style dimensions among DPT students based on age. Also, slightly higher percentages were found for sensing and visual among DPT students based on age for the corresponding sensing-intuitive and visual-verbal learning style dimensions.

There were no statistically significant differences among DPT students or PTA students across the four learning style dimensions (active-reflective, sensing-intuitive, visual-verbal, sequential-global) based on gender. The majority of students among DPT and PTA students were balanced on the active-reflective dimension, sensing on the sensing-intuitive dimension, visual

on the visual-verbal dimension, and balanced on the sequential-global dimension based on gender. Findings of interest among the PTA students show that 57% of the female students and 43.9 % of the male students were visual on the visual-verbal dimension. Also, on the visual-verbal dimension 56.1% of male and 43% of female students were balanced.

### Conclusions

Prajapati, Dunne, Bartlett, and Cubbidge (2011) studied the influence of learning styles, enrollment status, and gender on academic performance of optometry undergraduate students. The optometry student study used the Index of Learning Styles (ILS) by Felder and Soloman to assess learning styles. They found that the majority of students (48% to 64%) had a balanced learning style and a strong preference for the active, sensing, visual, and sequential aspects of the ILS dimensions (Prajapati et al., 2011); findings of the present study generally support these findings in that the majority of students were balanced on the active-reflective and sequential-global dimensions of the ILS. The sensing-intuitive and visual-verbal learning style dimensions of the present study found the majority of students were sensing and visual. However, when combined with students who were balanced approximately 96% of the students were sensing or balanced and visual or balanced on the corresponding continuum. Therefore, the present study closely supports the findings of Prajapati et al. (2011) with the majority of students being balanced learners and exhibiting a strong preference toward active, sensing, visual, and sequential learning styles.

Prajapati et al. (2011) found a statistically significant difference in the active-reflective and visual-verbal learning styles of males and females. Females on average were more likely to have a preference for the visual and reflective learning styles compared to males. Findings of the

present study did not support a statistical disproportionate preference for visual and reflective learning styles or any of the four learning style dimensions for females compared to males.

Brown et al. (2009) conducted a study to determine whether learning style preferences of health science students could predict their attitudes about e-learning. Included in the study were students in physical therapy, occupational therapy, nursing, and eight other healthcare disciplines. Brown et al. (2009) found that the health science student learning style preferences based on the ILS included: 44.4% were active learners compared to 23.4% reflective learners, 60% were sensing learners compared to 10% intuitive learners, 54% were visual learners compared to 6% verbal learners, and 64% were sequential learners compared to 8% global learners. Brown et al. (2009) did not report balanced scores. However, the present study generally supports the findings of the Brown et al. study with DPT and PTA students exhibiting a strong preference toward active, sensing, visual, and sequential preference on the four dimensions of the ILS.

Alumran (2008) conducted a study to investigate the preferred learning styles of Bahraini university students and the differences in their learning styles according to gender and field of study. Alumran used the ILS to assess learning styles. The study sample included students from all academic colleges at the university and consisted of 69.6% females and 30.2% males. The results of Alumran's (2008) study showed that the preferred learning styles on each of the four dimensions were: active over reflective, sensing over intuitive, visual over verbal, and sequential over global; the results did not report balanced scores. Alumran's results concurred with the results of the present study with a preference for active, sensing, visual, and sequential. Alumran (2008) found that males preferred the intuitive to the sensing learning style and that females

preferred the sensing learning style. The present study did not find any significant learning style preferences based on gender.

Zhang and Lambert (2008) investigated the learning styles and critical thinking dispositions of Chinese baccalaureate nursing students. Zhang and Lambert (2008) used the ILS to assess learning styles. The preferred learning styles across the four learning style dimensions were reflective, sensing, visual, and global. The present study did not find a preference for reflective (active-reflective) or global (sequential-global) learning styles. However, the present study supports the sensing and visual preferred learning style based on the four learning style dimensions.

Felder and Spurlin (2005) found that undergraduate engineering students at a variety of institutions were more active than reflective, more sensing than intuitive, more visual than verbal, and more sequential than global; the results of the present study support their findings.

Leahy, Gaughran, and Seery (2009) examined the preferential learning styles of 525 students attending school in Ireland with an age range of 12 to 16 years. The ILS was used to assess learning styles. The authors found that the preferential learning styles for the students in technology education were predominantly active over reflective and visual over verbal. Leahy et al. (2009) did not find a statistical significance between sensing and intuitive and sequential and global; the findings of the present study generally support those results with a distinct preference for active, sensing, visual, and sequential learning styles.

As a result of these findings, the following conclusions are drawn regarding the learning styles of DPT and PTA students. The researcher concludes that there is not a significant difference between the learning styles of DPT and PTA students. The DPT and PTA students in the present study were balanced on the active-reflective dimension, sensing on the sensing-

intuitive dimension, visual on the visual-verbal dimension and balanced on the sequential-global dimension. Preferences were toward the active, sensing, visual, and sequential learning styles. The findings of the present study generally support the results of other studies that used the ILS instrument to assess learning styles, especially for optometry, health science, and engineering students.

### Recommendations

Based on the findings of the present study, the following recommendations for practice and future research are proposed.

#### Recommendations for Practice

*Pedagogy.* Learning styles are not mutually exclusive categories but preferences as to how one perceives and processes information. Therefore, the aim of teaching is not to match teaching style to learning style but to achieve a balance in providing an instructional environment that addresses learning style preferences and provides pedagogical activities that strengthen as many learning styles as possible. The findings of this study show that both the DPT and PTA student's preferences are:

- Balanced on the active-reflective dimension with a preference toward the active; therefore, DPT and PTA students learn by trying things out and enjoy working in groups.
- Sensing on the sensing-intuitive dimension; therefore, DPT and PTA students are concrete thinkers, practical, and oriented toward facts and procedures.
- Visual on the visual-verbal dimension; therefore, DPT and PTA students prefer visual representations of presented material such as pictures, diagrams, and flow charts.

- Balanced on the sequential-global dimension with a preference toward sequential; therefore, DPT and PTA students learn in small incremental steps and prefer linear thinking processes.

Educators of DPT and PTA students should as much as possible create a learning environment that addresses the active, sensing, visual, and sequential learning style preference and provides activities to strengthen the reflective, intuitive, verbal, and global learning styles. This balance will help prepare the students for a successful career as a physical therapy professional within this ever-changing healthcare environment.

*Learning strategies.* Each learning style possesses its own strengths and weaknesses. However, one learning style is neither preferable nor inferior to another but is simply different. An awareness of learning styles will enable the learner to capitalize on their strengths and develop their areas of weakness. This ability to employ effective learning strategies will equip an individual for the challenges of his or her chosen profession and lifelong learning. One of the many advantages of Felder and Soloman's ILS is that the instrument is available online free of charge and includes learning strategies for each identified learning style. The capability for accessing learning strategies will help the student and teacher if remediation is required.

### Recommendations for Future Research

There are four recommendations for future research related to this study.

1. Similar studies could be conducted with the ILS for students in other academic programs to ascertain if learning style preferences influence students' tendencies to choose specific careers.
2. Similar studies could be completed with the ILS for nursing and other allied health students to expand the sampling base.



3. Similar studies could be conducted with the ILS for DPT and PTA students from multiple universities and community colleges throughout the nation to ensure a more expansive geographic representation.
4. Similar studies could be completed with the ILS to examine learning style preferences of physiotherapy students in other countries.

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## APPENDICES

### APPENDIX A

#### Index of Learning Styles Questionnaire\*

#### ILS Questionnaire

**DIRECTIONS:** Enter your answers to every question on the ILS scoring sheet. Please choose only one answer for each question. If both choice *a* and choice *b* seem to apply to you, choose the one that applies more frequently.

1. I understand something better after I
  - a. try it out.
  - b. think it through.
2. I would rather be considered
  - a. realistic.
  - b. innovative.
3. When I think about what I did yesterday, I am most likely to get
  - a. a picture.
  - b. words.
4. I tend to
  - a. understand details of a subject but may be fuzzy about its overall structure.
  - b. understand the overall structure but may be fuzzy about details.
5. When I am learning something new, it helps me to
  - a. talk about it.
  - b. think about it.
6. If I were a teacher, I would rather teach a course
  - a. that deals with facts and real life situations.
  - b. that deals with ideas and theories.
7. I prefer to get new information in
  - a. pictures, diagrams, graphs, or maps.
  - b. written directions or verbal information.
8. Once I understand
  - a. all the parts, I understand the whole thing.
  - b. the whole thing, I see how the parts fit.
9. In a study group working on difficult material, I am more likely to
  - a. jump in and contribute ideas.
  - b. sit back and listen.

10. I find it easier
  - a. to learn facts.
  - b. to learn concepts.
11. In a book with lots of pictures and charts, I am likely to
  - a. look over the pictures and charts carefully.
  - b. focus on the written text.
12. When I solve math problems
  - a. I usually work my way to the solutions one step at a time.
  - b. I often just see the solutions but then have to struggle to figure out the steps to get to them.
13. In classes I have taken
  - a. I have usually gotten to know many of the students.
  - b. I have rarely gotten to know many of the students.
14. In reading nonfiction, I prefer
  - a. something that teaches me new facts or tells me how to do something.
  - b. something that gives me new ideas to think about.
15. I like teachers
  - a. who put a lot of diagrams on the board.
  - b. who spend a lot of time explaining.
16. When I'm analyzing a story or a novel
  - a. I think of the incidents and try to put them together to figure out the themes.
  - b. I just know what the themes are when I finish reading and then I have to go back and find the incidents that demonstrate them.
17. When I start a homework problem, I am more likely to
  - a. start working on the solution immediately.
  - b. try to fully understand the problem first.
18. I prefer the idea of
  - a. certainty.
  - b. theory.
19. I remember best
  - a. what I see.
  - b. what I hear.
20. It is more important to me that an instructor
  - a. lay out the material in clear sequential steps.
  - b. give me an overall picture and relate the material to other subjects.
21. I prefer to study
  - a. in a study group.
  - b. alone.
22. I am more likely to be considered
  - a. careful about the details of my work.
  - b. creative about how to do my work.

23. When I get directions to a new place, I prefer
  - a. a map.
  - b. written instructions.
24. I learn
  - a. at a fairly regular pace. If I study hard, I'll "get it."
  - b. in fits and starts. I'll be totally confused and then suddenly it all "clicks."
25. I would rather first
  - a. try things out.
  - b. think about how I'm going to do it.
26. When I am reading for enjoyment, I like writers to
  - a. clearly say what they mean.
  - b. say things in creative, interesting ways.
27. When I see a diagram or sketch in class, I am most likely to remember
  - a. the picture.
  - b. what the instructor said about it.
28. When considering a body of information, I am more likely to
  - a. focus on details and miss the big picture.
  - b. try to understand the big picture before getting into the details.
29. I more easily remember
  - a. something I have done.
  - b. something I have thought a lot about.
30. When I have to perform a task, I prefer to
  - a. master one way of doing it.
  - b. come up with new ways of doing it.
31. When someone is showing me data, I prefer
  - a. charts or graphs.
  - b. text summarizing the results.
32. When writing a paper, I am more likely to
  - a. work on (think about or write) the beginning of the paper and progress forward.
  - b. work on (think about or write) different parts of the paper and then order them.
33. When I have to work on a group project, I first want to
  - a. have "group brainstorming" where everyone contributes ideas.
  - b. brainstorm individually and then come together as a group to compare ideas.
34. I consider it higher praise to call someone
  - a. sensible.
  - b. imaginative.
35. When I meet people at a party, I am more likely to remember
  - a. what they looked like.
  - b. what they said about themselves.

36. When I am learning a new subject, I prefer to
  - a. stay focused on that subject, learning as much about it as I can.
  - b. try to make connections between that subject and related subjects.
37. I am more likely to be considered
  - a. outgoing.
  - b. reserved.
38. I prefer courses that emphasize
  - a. concrete material (facts, data).
  - b. abstract material (concepts, theories).
39. For entertainment, I would rather
  - a. watch television.
  - b. read a book.
40. Some teachers start their lectures with an outline of what they will cover. Such outlines are
  - a. somewhat helpful to me.
  - b. very helpful to me.
41. The idea of doing homework in groups, with one grade for the entire group,
  - a. appeals to me.
  - b. does not appeal to me.
42. When I am doing long calculations,
  - a. I tend to repeat all my steps and check my work carefully.
  - b. I find checking my work tiresome and have to force myself to do it.
43. I tend to picture places I have been
  - a. easily and fairly accurately.
  - b. with difficulty and without much detail.
44. When solving problems in a group, I would be more likely to
  - a. think of the steps in the solution process.
  - b. think of possible consequences or applications of the solution in a wide range of areas.

\* Copyright © 1991, 1994 by North Carolina State University (Authored by Richard M. Felder and Barbara A. Soloman). For information about appropriate and inappropriate uses of the Index of Learning Styles and a study of its reliability and validity see <http://www.ncsu.edu/felder-public/ILSpage.html> Retrieved from <http://www.engr.ncsu.edu/learningstyles/ilsweb.html>

## APPENDIX B

### Index of Learning Styles Report Form

#### ILS REPORT FORM

**ACTIVE** \_\_\_\_\_ **REFLECTIVE**

11a 9a 7a 5a 3a 1a 1b 3b 5b 7b 9b 11b

**SENSING** \_\_\_\_\_ **INTUITIVE**

11a 9a 7a 5a 3a 1a 1b 3b 5b 7b 9b 11b

**VISUAL** \_\_\_\_\_ **VERBAL**

11a 9a 7a 5a 3a 1a 1b 3b 5b 7b 9b 11b

**SEQUENTIAL** \_\_\_\_\_ **GLOBAL**

11a 9a 7a 5a 3a 1a 1b 3b 5b 7b 9b 11b

- If your score on a scale is 1-3, you are fairly well balanced on the two dimensions of that scale.
- If your score on a scale is 5 or 7, you have a moderate preference for one dimension of the scale and will learn more easily in a teaching environment that favors that dimension.
- If your score on a scale is 9 or 11, you have a very strong preference for one dimension of the scale. You may have real difficulty learning in an environment that does not support that preference.

See *Learning Styles and Strategies* by Richard Felder and Barbara Soloman for explanations of your preferences on the individual scales at

<http://www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/styles.htm>



## APPENDIX C

### Student Demographic Information Form

1. Program of Study:
  1. \_\_\_\_\_ Doctor of Physical Therapy
  2. \_\_\_\_\_ Physical Therapist Assistant
  
2. Gender:
  1. \_\_\_\_\_ Male
  2. \_\_\_\_\_ Female
  
3. Please indicate your age in years at your last birthday:  
\_\_\_\_\_ Years
  
4. Which of the following best describes your race? (You may select more than one.)
  1. \_\_\_\_\_ American Indian or Alaskan native
  2. \_\_\_\_\_ Asian
  3. \_\_\_\_\_ Black or African American
  4. \_\_\_\_\_ Hispanic or Latino
  5. \_\_\_\_\_ Native Hawaiian or other Pacific Islander
  6. \_\_\_\_\_ White
  
5. What is your highest level of education in any area of study? (Select only one.)
  1. \_\_\_\_\_ High School Diploma or GED
  2. \_\_\_\_\_ Associates
  3. \_\_\_\_\_ Baccalaureate degree
  4. \_\_\_\_\_ Master's degree
  5. \_\_\_\_\_ PhD (or equivalent, e.g., EdD or ScD)

## APPENDIX D

### Participant Informed Consent Form

#### **INFORMED CONSENT FORM**

##### **Study Title**

Learning Styles of Physical Therapy and Physical Therapist Assistant Students in Accredited Physical Therapy Programs

##### **Purpose of the Study**

The purpose of this research study is as follows:

- a. To determine if there is a significant difference between Physical Therapy and Physical Therapist Assistant students learning style preference in each of the four dimensions of the Felder-Soloman Index of Learning Styles Inventory.
- b. To determine between Physical Therapy and Physical Therapist Assistant students if there is a significant difference between male and female learning style preference in each of the four dimensions of the Felder-Soloman Index of Learning Styles Inventory.
- c. To determine among Physical Therapy and Physical Therapist Assistant students if there is a significant difference among age groups learning style preference in each of the four dimensions of the Felder-Soloman Index of Learning Styles Inventory.

##### **Procedures**

You will be asked to complete the Felder-Soloman Index of Learning Styles survey and a demographic form. Prior to the completion of the survey, you will be provided information about the research topic and given the opportunity to make a decision to participate or not participate. The survey should take approximately 30 minutes.

##### **Confidentiality**

Information collected during the study will be kept confidential and anonymous. No identifiable information is requested or collected. This means that the information collected does not identify you in the research.

##### **Potential Risks and Costs**

There are no anticipated risks from participating in this research. There are no monetary costs associated with this study.

##### **Investigator Information**

Ann Lowdermilk  
Doctoral Candidate and Investigator  
East Tennessee State University  
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Dr. James Lampley, Faculty Advisor  
Associate Professor  
East Tennessee State University  
[lampley@etsu.edu](mailto:lampley@etsu.edu)

**Benefits**

There are no direct benefits to you; however, information from this study may benefit Physical Therapy and Physical Therapist Assistant educators and students in the future. The study of learning styles adds to the overarching body of knowledge related to learning.

**Participants Rights and Consent**

Your participation in this study is voluntary.

Completion of the learning styles survey indicates that:

- a. you have read and had the opportunity to ask questions about the study, and,
- b. you voluntarily agree to participate in the study.

If you do not wish to participate in the study, do not complete the learning styles survey. You may discontinue the completion of the survey at any time.

***THANK YOU FOR YOUR PARTICIPATION IN THIS SURVEY!***

VITA

MARGARET A. LOWDERMILK

- Education: East Tennessee State University, Johnson City, TN, Educational Leadership, Ed.D.  
East Tennessee State University, Johnson City, TN, Physical Therapy, B.S., *Magna Cum Laude*  
George Williams College, Downers Grove, IL, Exercise Physiology and Preventive, Rehabilitative Cardiovascular Health, M.S.  
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US Army Reserve – 4212<sup>th</sup> USAH, Physical Therapist (65B)  
Health South, Physical Therapist  
The Therapy Center, Inc., Physical Therapist  
Johnson City Medical Center, Director of Community Health and Wellness Services; Physical Therapist
- Publications: Gilbert, .S, Derley, A., Lowdermilk, A., & Panus, P.C. (2000). Nontreatment variables affecting return-to-work in Tennessee-based employees with complaints of low back pain. *Tennessee Medicine*, 93, 167-171.  
Lowdermilk, A., Panus, P.C., & Kalbfleisch, J.H. (1999). Correlates of low back pain outcomes in a community clinic. *Tennessee Medicine*, 02, 302-305.