2000

Physical Therapy Student Learning Styles And Their Preference For Teaching Methods And Instructional Activities

Valerie Gwen Olson
Seton Hall University

PHYSICAL THERAPY STUDENT LEARNING STYLES AND THEIR PREFERENCE FOR TEACHING METHODS AND INSTRUCTIONAL ACTIVITIES

By

Valerie Gwen Olson

Dissertation Committee:

Professor Craig Scanlan, Chair
Professor Genevieve Pinto-Zipp
Professor Mary Ann Clark

Approved by the Dissertation Committee:

Craig L Scanlan Date 4/25/00

Genevieve Pinto Zipp Date 4/25/00

Mary Ann Clark Date 4/25/00

Submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in Health Sciences
Seton Hall University & University of Medicine and Dentistry of New Jersey
2000

PHYSICAL THERAPY STUDENT LEARNING STYLES AND THEIR PREFERENCE FOR TEACHING METHODS AND INSTRUCTIONAL ACTIVITIES

Valerie Gwen Olson, MS, PT

Seton Hall University and
the University of Medicine and Dentistry of New Jersey
2000

Chair: Craig Scanlan, EdD, RRT, FAARC

This study tested the assumption that students' learning styles (LS) express themselves in preferences for various teaching methods and instructional activities (IA). The study also provided an updated profile on the learning styles of physical therapy (PT) students.

190 post-baccalaureate PT students were surveyed to determine their demographics characteristics, their LS, and their TM and IA preferences. LS was measured using the Gregorc Style Delineator (GSD), which yields four basic style dimensions: concrete-sequential (CS), abstract-sequential (AS), abstract-random (AR), and concrete-random (CR). The TM and IA scales were constructed from items identified in the relevant literature.

Respondents were mainly high-achieving, young Caucasian females. The predominant learning style was CS (31%). An unexpectedly high percentage of students exhibited a "dual" style (34%), with most of these having a CS component. No practically significant relationships were observed between students' LS and their demographics.

The TM and IA scales were factor analyzed to derive subject scores.

Four TM factors were identified: Collaborative, Self-Directed, Detailed, and Structured. Four IA factors also were identified: Naturalistic, Sensory-Driven, Theme-Oriented, and Traditional. Grouped by LS, respondents' TM and IA factor scores were compared using one-way ANOVA. On the TM factors, CR over AS learners had significantly higher Self-Directed scores, while CS over CR learners had significantly higher Structured Teaching scores. No significant differences in IA factor scores were observed among the LS groups. Bivariate correlation analysis between respondents' LS scores and their TM and IA factor scores revealed a few statistically significant but weak relationships.

This study provides only minimal support for the assumption that students' LS express themselves in TM and IA preferences. This conclusion may be due to weaknesses in the Gregorc model, or to the influence of confounding factors. Among the potential factors requiring further study is the high proportion of "dual" style learners. If the dual style represents adaptation to diverse TM and IA, then these learners would be less likely to express strong preferences for any singular strategy. In addition, the updated profile of PT students as predominantly CS learners has important implications for educators, especially in light of the current trend away from traditional teaching/learning models.

ACKNOWLEDGEMENTS

With great appreciation to:

Craig Scanlan, EdD, RRT, for his unselfish efforts and time as my Dissertation Committee Chair and professional mentor, in particular, as a role model demonstrating his love for life-long learning as well as creative use of educational technology;

Genevieve Pinto-Zipp, EdD, PT, for the overabundant doses of encouragement, and the intellectual "sparring" that afforded unlimited opportunities to reflect and explore "outside" the box;

Mary Ann Clark, EdD, PT, for the opportunity to glean from the breadth and depth of her professionalism as a physical therapist and as an administrator in health science education;

GiGi Sico and Sue Bohinek, for the friendships and in their ability to maintain my "homeostasis".

From the personal side, with great appreciation to:

Howard Dong, my father, who fostered the importance of education, and Mabelle Dong, my mother, who has provided unlimited tangible and intangible resources;

Woo Shee Dong, my paternal grandmother, who called me "Doctor" decades ago, and Lee See Chin, my maternal grandmother, who demonstrated persistence and practicality throughout her 115 years of life;

Archer Dong, EdD, my big brother, who lovingly served as my "in-house" mentor and resource, and;

Vanessa Dong, my sister, who provided the moral and technical support while bonding in the majestic mountains of Whistler.

DEDICATION

To my sons, Tim, Tyler, and Tate Olson, three wonderful individuals who have taught me about life through their growth and development; more importantly, who have brought tears of laughter and hugs of encouragement for the past 17 years, with more to come, and;

To my husband and best friend, Don Olson, who has fostered the gift of Life during our time together over the last two decades, with anticipation of richer times in the future.

I dedicate this work to you for your unceasing love and prayers for our Creator's blessings during this time of growth.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter I

INTRODUCTION

Background of the Problem

The various preferences physical therapy students express for teaching methods and instructional activities have perplexed educators. At the end of a course, evaluations completed by students reveal different didactic and psychomotor outcomes pertinent to the usefulness and application of the course to the field of physical therapy. Some students prefer learning activities that involve games or simulations, problem-solving and critical thinking activities, and a stimulus-rich environment where there are multifaceted learning experiences. Other students enjoy handouts and workbooks complemented with programmed instruction. Some students find step-by-step explicit instructions appealing, compared to those who indicate peer interaction or independent study as the preferred means. Instructors' use of student preferences may serve as a catalyst for effective instructional planning and implementation in the physical therapy professional curriculum, as well as for effective student advisement throughout their academic tenure.

Student preferences for different teaching methods and instructional activities are attributed to a number of reasons. Often, student preference for specific teaching methods or instructional activities can be ascribed to either

familiarity with the instructional means (which provide previous insight or practice) or positive outcomes, such as grades. A less understood but perhaps a more significant factor is the student's learning style. Learning style, a relatively stable characteristic, is defined as the individual's typical means to gain, process, and store information during an activity (Claxton & Murrell, 1987).

In 1971, Kolb developed a theoretical foundation for the concept of learning style (Kolb, 1984; Fox, 1984). In his model, Kolb proposes four major stages. Adult learning processes include having a concrete experience (Stage 1), followed by reflective observation of the experience (Stage 2). The experience then undergoes abstract conceptualization (Stage 3), which subsequently leads to testing the generalization in new situations through active experimentation (Stage 4). During this last stage, a new concrete experience develops. Experiential learning develops at increasing levels of complexity with continued practice.

According to Kolb's theory, a bi-polar process of learning creates two continua, with concrete experience being the polar opposite of abstract conceptualization, and active experimentation being the opposite of reflective observation. Learners demonstrate natural tendencies for one end of the spectrum over the other. This model is the foundation of the Kolb Learning Style Inventory (LSI).

A number of significant relationships have been identified among learning styles, including gender, personality types, career aspirations, academic achievement and college retention, and developmental level. Studies have revealed distinctive differences between male and female students, major area of study, academic grades, and study habits (O'Brien, 1991; Drummond & Stoddard, 1992; Nelson, Dunn, Griggs & Primavera, Fitzpatrick, Bacilious & Miller, 1993). These types of studies have resulted in the development of educational strategies to empower students and faculty to improve the learning process and environment. Based on the results, educational approaches emphasizing learning styles have been used. "Cognitive learning style intervention", an educational approach used to improve study skills as related to cognitive styles, has been addressed to determine the relationship with grade point average (GPA) and retention rates of undergraduate students (Nelson et al., 1993).

The documentation of learning styles, related to preferences of teaching methods and instructional activities, is limited in the health-care disciplines. In the field of nursing, learning style preferences of baccalaureate students, as well as cognitive styles associated with scores on the national licensing examination, have been investigated (Merritt, 1983; O'Brien & Wilkinson, 1992). The importance of matching the learning preference and personality characteristics in short-term critical-care nursing preceptor programs has been addressed. In situations where there is no

match, discussion of the differences have fostered improved communication and have generated choices of effective collaboration in order to minimize conflict and maximize teaching methods and instructional activities (Carroll, 1992). Learning styles and environmental preferences of physician assistants have also been studied (Rahr, Schmalz, Blessing & Allen, 1991). Relationships between learning styles and clinical performance have been explored to determine predictors for clinical performance in occupational therapy (Stafford, 1986).

Both students' and instructors' cognitive learning styles are believed to influence the efficacy of learning (Gregorc & Butler, 1984). Studies have primarily supported the need for student and instructor similarity in learning styles and educational strategies; however, they have been performed primarily at an undergraduate level (Merritt, 1983; Stafford, 1986, O'Brien & Wilkinson, 1992; Nelson et al., 1993). The literature has addressed the use of cognitive learning styles in continuing education using a narrative approach (Fox, 1984).

In professional education for entry-level physical therapy students and practicing clinicians, there is a lack of documented evidence as to the best avenues for learning. Payton, Huetter & McDonald (1979) and Payton, Huetter, McDonald & Hirt (1980) investigated physical therapy student learning style preferences, and physical therapy faculty instructional style preferences, respectively, nationwide. Using descriptive statistics, the authors

described only the profiles of each group. There is a hiatus of research related to physical therapy student learning styles since the publication of these studies.

Professional education must provide entry-level physical therapy students educational opportunities to master the theoretical foundation for practice and the cutting-edge therapeutic approaches. In theory, the most effective teaching methods and instructional activities, as related to students' preferences and learning styles, should maximize learning outcomes. Research to validate these relationships is essential.

Statement of the Problem

The following questions are posed based on the need to determine the preferred teaching methods and instructional activities which lead to mastery of the essentials in physical therapy education and to positive student attitudes towards the experience.

1. What are the learning style preferences of physical therapy students?
2. Do these styles correspond to known demographics, such as age, gender, or number of years of post-secondary education?
3. Are there logical relationships between learning style and preferred teaching methods, and instructional activities?

Purposes of the Study

The primary purpose of this study is to determine if there are significant relationships between learning style and preferred teaching methods and instructional activities. Secondary purposes are to investigate the learning styles of physical therapy students and to assess if these styles relate to known demographics, such as age, gender, ethnicity, and number of years of post-secondary education.

Definition of Terms

Learning Style. This is defined as the individual's typical means to gain, process, and store information during an activity.

Instructional Activities. These are educational avenues implemented in the classroom to foster learning (e.g., experiments, lecture, personal content, textbooks, group discussion, workbooks, handouts, simulations, mini-lectures, audiotapes, use of media, drills, demonstrations, practical application, critical issues, documented evidence, individual work, use of theme instead of detail, hands-on practice, interactive video).

Teaching Methods. Teaching methods include strategies used by the instructor to promote learning (e.g., uses trial and error discovery, uses programmed instruction, fosters aesthetic or interpretative products, guides individual study, enforces orderly classroom and lab, assigns optional reading, insists upon student independent thinking, provides manuals and projects, enhances the mood of the class, teaches from a base of content

expertise, personalizes the class, provides long-range planning, employs computer-aide information).

Dependence-Independence Variables of Cognitive Styles. These variables are described as the underlying individual differences in performance, in particular, how an individual perceives (Witkin, Oltman, Goodenough, Friedman, Owen & Raskin, 1977). The continuum consists of field dependence, where the individual's perception is analytical and is dominated mainly by the prevailing field, versus field independence, where the individual's perception is separate from the surrounding field.

Hypotheses

The research hypotheses are as follows: 1): logical relationships exist between learning styles and demographics, and 2) students grouped by learning styles differ in their preference for both teaching methods and instructional activities.

Chapter II

REVIEW OF LITERATURE

An individual's personality, the innate being, is the underlying catalyst which drives all thought processes, learning, actions, and reactions in every day living. Stimuli, personal interaction, and the environment influence the personality; however, the personality remains the "foundation" of a person's unique characteristics of existence.

Theoretical Foundations of Personality

In developing categorizations of behavior, Carl Jung's model of personality was initially developed in 1923 (Jung, 1961; Borokos, Goldstein & Sweeney, 1992; Harasym, Leong, & Juschka (1996); Harasym, Leong, Juschka, Lucier & Lorscheider, 1995a). Jung's personality types included three orthogonal, bipolar dimensions: 1) a perceiving dimension, which described the ability to process information--Sensing versus Intuition; 2) a judging dimension, which assessed problem-solving skills--Thinking versus Feeling; and 3) an attention dimension, which identified the natural tendency to use internal focus as compared to external focus--Introverted versus Extroverted. This model of personality types provided the background for ensuing research in personality and cognitive styles.

The framework of learning style models and related research can be analogous to an onion, which is composed of several layers. Claxton and Murrill (1987) described the four sequential interactive layers of an onion to represent personality at the core, followed by information processing, social interaction, and instructional preference. The "style" was most stable at the core purporting that personality was the characteristic to undergo the least change in response to the influence of the instructor or researcher. As one moved outward to the next layers, the traits or preferences decreased in stability and increased in vulnerability to change, which was the reason, according to these educators, why reliability and validity tests of learning styles were inconsistent in the related literature.

In 1976, personality models began to examine the dependence-independence variables of cognitive style. Witkin et al. (1977), renown for his 50 years of research on cognitive styles, developed tools to investigate field dependence-independence, such as the rod-and-frame test, the body-adjustment text, and the embedded-figures test (Claxton & Murrill, 1987). Field dependence relied upon the concrete environment to assess and address problems, while field independence used internal mechanisms to determine solutions to problems. Genetic factors appeared to be the primary reason of one's interpretation; however, socialization and family interaction also contributed to the types of style. Regarding the use of personality, past research also covered relationships with cross-cultural issues, student

selection of major and career, gender differences, as well as the match and mismatch of student and teacher personality styles.

The theoretical foundation of the Myers-Briggs Type Indicator (MBTI), the most widely used instrument in counseling, education, and industrial environments, is a modified framework of Carl Jung's personality types (Harasym, Leong, Juschka, Lucier & Lorsheider, 1995b; Harasym et al., 1996; Borokos et al., 1992; Drummond & Stoddard, 1992). Based upon the three bipolar dimensions, perceiving, judging, and person's attitude towards life, individuals interpret the incoming information and make decisions. An introverted or extroverted manner is defined by the direction an individual uses their energy. The MBTI consists of an additional dichotomous scale: Judging, which describes one who prefers to plan and control events, versus Perception, which describes one who prefers to wait to see what happens and reacts spontaneously. The information gleaned from the MBTI provides students and instructors insight as to how a personality type thinks, asks questions, and prefers different means of information dissemination.

The MBTI is cited in numerous research studies to purport the differences in learning styles (Harasym et al., 1996; Borokos et al., 1992; Drummond & Stoddard, 1992). As investigators gained more information about personality types, the next layer of the onion, information processing, became an area of great interest.

Learning Styles

Information-processing models focus on the natural avenues individuals process information from the environment. Learning style is defined as the individual's typical means to gain, process, and store information during an activity. This is considered a stable characteristic, and each individual has a natural tendency to interact with his or her environment in ways associated with his/her learning style. Some learners have adjusted to "function" in a learning style that is unnatural; however, under stress, individuals resort to their predominant styles.

Related research has identified significant relationships of cognitive learning styles with:

1) numerous measures of cognitive style to assess similarities among various classification systems (Bokoros et al., 1992; Joniak & Isaksen, 1988);

2) characteristics of learners such as gender, college major, academic retention and achievement, and career selection (O'Brien, 1994; Nelson et al., 1993; Payton et al., 1979; Payton et al., 1980);

3) environmental preferences, preceptor programs, clinical education, and performance on national licensure examination, specifically related to health professions (Payton et al., 1979; Payton et al., 1980; Rahr et al., 1991; Carroll, 1992; Stafford, 1986; O'Brien & Wilkinson, 1992) and;

4) teaching methods, described anecdotally in a nursing preceptor program, a secondary education automotive mechanics program, and in a physical therapy program (Carroll, 1992; Thompson, 1989; Gaden, 1992).

O'Brien (1994) discussed high academic achievement, also measured by the cumulative GPA, and its association with the concrete-sequential cognitive style, in contrast to the lower GPA and its association with the abstract-random type. Ginter et al. (1989) revealed that learning style type differed significantly in relation to age rather than to class standing or gender. Significant increments in the GPA of business majors were attributed to improving study skills associated with the students' learning styles (Dunn, Deckinger, Withers & Katzenstein, 1990). Nelson et al. (1993) studied the increased GPA and higher retention rates of students who improved study skills and the relationship to cognitive styles, when compared to students who did not experience "cognitive learning style intervention."

Comparison of Learning Styles

Bokoros et al. (1992) compared and contrasted common factors in five measures (the Myers-Briggs Type Indicator, Gregorc Style Delineator, Learning Style Inventory, Decision Style Indicator, and Lifescripts) of cognitive style and found that three underlying dimensions were evident despite differences in the terminology and the theoretical bases of the instruments. In assessing 143 students and faculty, the three common

themes in the five measures consisted of a thinking-feeling dimension, an information-processing domain, and an attentional-focus dimension. The Gregorc Style Delineator (GSD) is the measure of interest for the purpose of this literature review.

Learning Styles in Health Professions

Cognitive learning styles have been correlated with many characteristics of learners. The GSD and the Rahr Learning Environment Preference (RLEP) were tools employed by Rahr et al. (1991) who studied 281 students (98 nursing and 183 allied health undergraduate students majoring in occupational and physical therapy, physician assistant and medical technology). The RLEP used students' Likert scale responses of 1 to 5 to assess prerequisite coursework, learning strategies, study settings (including light and sound levels), and preferred times of the day for study. Independent study and laboratory have been identified as the preferred means of learning, followed by lecture and note taking. Environmental choices consisted of quiet, isolated and informal settings either in the evening, late evening or mid-morning. Student characteristics of the Gregorc learning styles, cumulative GPA, or the status of junior or senior level were not indicative of a significant correlation.

Carroll (1992) discussed the importance of matching the learning preference and personality characteristics in short-term critical care nursing preceptor programs. The one-to-one pairing performed through the use of

the GSD, provided the preceptor the option to explore different teaching methods according to the novice nursing preference, thereby it enabled entry-level nurses to learn more efficiently. However, if a "match" was not available, the preceptor and learner discussed their cognitive styles that would promote greater understanding of its relationship to collaboration and learning. The preceptor and learner mutually addressed avenues to adapt to the differences. These efforts minimized conflict and facilitated learning by using teaching and learning strategies relevant to their learning styles, as purported by Gregorc (1979). Should the relationship prove unproductive, the use of early intervention was recommended, and an objective plan of action to rectify the dilemma should be developed and implemented.

In an unpublished doctoral dissertation, Gaden (1992) assessed the teaching techniques of instructors from four physical therapy programs and found that one program used instructional strategies that addressed three of the GSD learning styles, and the remaining three programs used instructional strategies that encompassed all four of the GSD learning styles. Consequently, these students were exposed to numerous teaching methods and instructional activities throughout their academic tenure, including their professional curriculum.

Gregorc Style Delineator

The Gregorc Mediation Ability Theory, which addresses different learning style preferences, purports that the human mind has channels

through which it receives and expresses information most efficiently and effectively (Gregorc 1982a, 1982b). The Gregorc Style Delineator (GSD), an instrument used to determine which of the four mediation channels is predominant in an individual, is based upon two types of mediation abilities: perception and ordering. In this context, perception refers to the way in which an individual grasps information, ranging from abstract (dealing with ideas, and using emotion and intuition) to concrete (direct use of the physical senses). Ordering refers to the way in which a person arranges and systematizes information, ranging from sequential (tendency to organize material in a linear, step-by-step, methodical, predetermined) to random (tendency to use information in a non-linear, leaping manner and prefers numerous, diverse and independent components).

Four distinct mind mediation channels emerge: concrete-sequential (CS), abstract-sequential (AS), abstract-random (AR), and concrete-random (CR) (refer to Figure 1). An individual would reveal a predisposition to one or, possibly, two or three of the four mind mediation channels, also referred in the literature as cognitive learning styles (refer to Table 1).

Teaching Methods and Practices

Both students' and instructors' cognitive learning styles are believed to influence the efficacy of learning. Instructors have exhibited specific patterns of classroom teaching behaviors associated with each of Gregorc's four mediation channels, as described by Butler (1988). In addition, Gregorc and

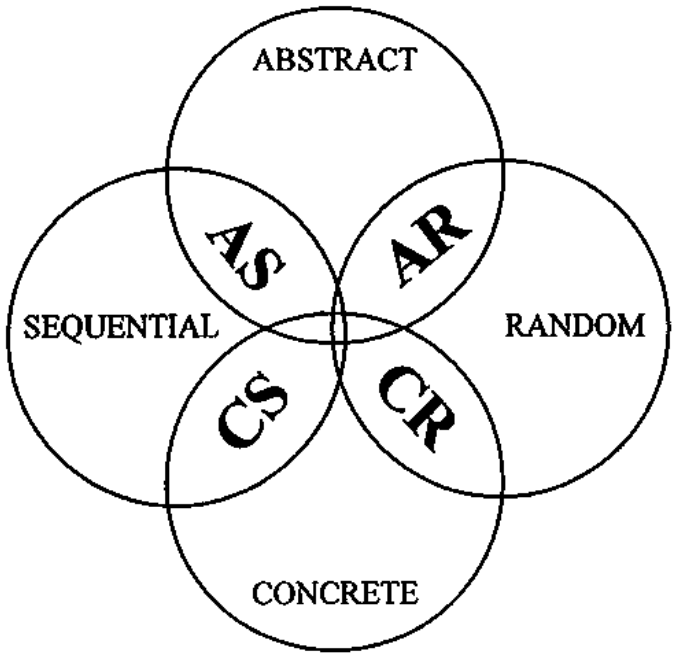


Figure 1

The Gregorc Four Mediation Channels or Learning Style Model

AS = Abstract-Sequential
AR = Abstract-Random
CR = Concrete-Random
CS = Concrete-Sequential

Table 1

The Gregorc Model: Characteristics of the Four Mind Mediation Channels*

Mind Mediation Channel	Characteristics
Concrete-sequential (CS)	structured, practical, predictable, thorough
Abstract-sequential (AS)	logical, analytical, conceptual, studious
Abstract-random (AR)	sensitive, sociable, imaginative, expressive
Concrete-random (CR)	intuitive, original, investigative, able to solve problems

*Taken from: Butler, K. (1988). Learning styles. *Learning*, 88, 30-34.

Butler (1988) have outlined students' dominance in each of the four Gregorc cognitive styles and associated types of learning activities (see Table 2), emphasizing the importance of flexibility and creativity in the instructional process to allow for student cognitive style differences, in contrast to the typical highly factual concrete-sequential curriculum.

Thompson (1989) examined the teaching and learning process in secondary education automotive mechanics programs to ascertain if the teaching methods employed by instructors were the same methods ascribed to the preferred learning styles of teachers and students. Six instructors, identified as exemplary by colleagues and local school district administration, participated in the study, which included the objective observation of classroom and lab instructional activities and program management. The purpose of the investigation was to determine which learning style was predominant for the exemplary instructor by using a checklist of teaching methods associated with each type of Gregorc's mediation channels (refer to Table 2), to assess the number of non-dominant behaviors used in instruction. All six instructors in Thompson's study were categorized from medium to high in the concrete-sequential mediation channel which was reflected in the chosen instructional activities such as step-by-step directions, order in classroom and lab activities, and predetermined rules for use of equipment and supplies. These instructional activities expanded the students'

Table 2

Media, Teaching Methods and Practices*

Abstract Sequential	Abstract Random	Concrete Sequential	Concrete Random
• Lecture • Textbooks • Audiotapes • Documented evidence • Study Carrels • Likes scope & sequence • Evaluate by formal testing • Intellectual debate • Guided individual study • Likes long-range plans • Teach from a base of content expertise • Supplemental reading assignments • Develop blueprint from an idea to visualize final product	• Group discussion • Use media • Flexible with time demands • Personalized classes • Concerned with mood of class • Use thematic approach to content • Create aesthetic or interpretative products • Assign group rather than individual activities	• Workbooks • Handouts • Drill • Demonstrations • Results-oriented • Practical lessons • Hands-on practice • Projects • Models • Manuals • Step-by-step directions • Programmed instruction • Orderly classroom • Orderly lab • Direct application problems • Computer-aided information	• Experiments • Simulations • Mini-lectures • Critical issues • Interactive video • Problem-solving curriculum • Independent study • Computer and other games • Trial and error discovery • Optional reading assignments • Invent new ways of doing things • Stress challenges and probing questions • Insist students think for themselves

*Taken from: Gregorc, A. & Butler, K. (1984). Learning is a matter of style.; and Thompson, M. (1989). Validation of the Gregorc learning style model.

previous knowledge and experience. In addition, instructors used teaching methods, media, and management practices relevant to other mediation channels (e.g., encouraging creativity, problem-solving in a random manner associated with the concrete-random approach, or using a large or small group discussion seen in an abstract-random learning style).

Past research explored comparisons of the GSD with characteristics of 1) other cognitive style measures, 2) learners--such as cumulative GPA, age class standing, gender, and career choice, 3) environmental preferences, and, 4) teaching methods, anecdotally described in a nursing preceptor program and a secondary education automotive mechanics program. One study (Fox, 1984) captured learner satisfaction using a course evaluation in continuing education, but used a different measure, the Learning Style Inventory, instead of the GSD.

The studies, described in this literature review, used the GSD but did not investigate the mediation channels identified for students as related to students' learning preferences (Rahr et al., 1991; O'Brien, 1991, 1994; Carroll, 1992; Gaden, 1992; O'Brien & Wilkinson, 1992). It is essential that further research be implemented to identify the cognitive learning styles associated with students' learning preferences in order for students and faculty alike to be more effective in learning and student advisement. Based on this review of the literature, the potential utility of assessing students' learning styles is clear. However, no significant relationships have been

demonstrated between students' learning styles and their preferences for teaching methods or instructional activities. If progress is to be made in applying learning styles to the teaching/learning process, we must first establish these relationships.

Chapter III

METHODS

Research Design

The research design was a causal-comparative analysis of the relationships between and among the selected demographic criteria, teaching methods, instructional activities, and the dominant Gregorc style. The method of data collection was survey, which consisted of a questionnaire delineating demographic information (gender, age, and number of years of post-secondary education), preference scales (teaching methods and instructional activities), and the Gregorc Style Delineator (GSD). The teaching methods and instructional activities preference scales employed selected criteria from past research. The media, teaching methods and practices identified by Thompson (1989), and the Gregorc Mediation Ability Theory formed the criteria to analyze the preferences of physical therapy students with different learning styles. Gregorc and Butler (1984) and Carroll (1991) outlined the Gregorc learning styles and associated teaching methods and instructional activities. The information was collated and the data were analyzed. The study times and study settings employed by Rahr et al. (1991), were incorporated in the data collection, but they will be used for a future research study beyond the scope of the present project.

Subjects

The subjects consisted of physical therapy students who volunteered to participate from a population of 264 individuals, enrolled in the joint entry-level graduate programs of the University of Medicine and Dentistry of New Jersey-Newark Campus, in collaboration with Seton Hall University and Kean College; the University of Medicine and Dentistry of New Jersey-Camden Campus, in collaboration with Rutgers University, as well as the Richard Stockton State College.

Instrumentation

The survey was the instrument used to collect the data (refer to Appendix C). A pilot study was conducted to elicit constructive criticism regarding the format of the questionnaire and clarification of the statements. Occupational therapy and physical therapy students (N = 38) from Dominican College, Orangeburg, New York, who volunteered to complete the questionnaire, were instructed to read the cover letter and complete the questionnaire as described, as well as to add any constructive criticism that would make it user-friendly and easier to understand. The cover letter, which briefly explained the doctoral research project, the voluntary participation, the anonymity of the respondents, and the means for feedback, was attached in front of the survey. Based upon the feedback from the pilot study, the directions for each section were added and/or modified, and one item under III. Teaching Methods was reworded to "Fosters creative products."

The survey consisted of six sections: I. Biographic Inventory, II. Gregorc Style Delineator (GSD), III. Teaching Methods, IV. Study Settings, V. Study Time, and VI. Instructional Activities. Students who participated in this research study were first instructed to read the cover letter and complete only Section I: Biographic Information, by providing demographic information, through phrases/questions pertaining to gender, age, ethnicity, current year in the professional program, and the number of full-time and part-time years of post-secondary education. Upon completion of the demographic information, the investigator reviewed the GSD standardized directions for the Word Matrix on the subsequent page. Students completed the GSD Word Matrix by rank-ordering the four words that best described themselves. The score of 4 was used as the best descriptive word, and 1 as the least descriptive word. Students were allotted four minutes to complete the Word Matrix. In order to eliminate respondents' ability to detect the pattern of the words associated with a particular learning style presented in that row, the format of the Word Matrix was modified based upon the recommendations of 1) the literature review (Joniak & Isaksen, 1988) and 2) the Dissertation Committee at the Proposal Hearing. Dr. Gregorc, the author of the GSD, redesigned the Word Matrix by removing the boxes respondents used to sum the rank-ordered words by rows, followed by columns. The use of this procedure determined the respondents' final scores for each of the four learning styles.

Students continued working on the questionnaire by completing four preference scales, which addressed 14 teaching methods and 20 instructional activities selected from the framework of Gregorc's learning styles (Gregorc & Butler, 1984; Carroll, 1991), as well as study settings and study times. The study settings and study times were adapted from the framework of Rahr et al. (1991). In order to indicate their preferences on the scales, students were instructed to circle the number that best represented their preferences. On a scale of 1 to 5, students indicated their preferences by circling 5 to represent an item that was highly preferred, 3 to indicate that the response was neutral, and 1 to represent an item that was not preferred. As directed in the cover letter, those students interested would receive a summary of the outcomes at a future date.

GSD Reliability. The use of the GSD, as an instrument to identify learning styles, is supported in the literature (Gregorc, 1984a; 1984b; Thompson, 1989; O'Brien, 1990; O'Brien & Wilkinson, 1992). In testing 110 adults, Gregorc (1984a), the author of the GSD, determined the reliability of the GSD to be a standardized alpha coefficient ranging from .89 to .93 at the $p < .001$ level, indicating that the four subscales of styles demonstrate a strong level of internal consistency. The coefficients were as follows: AR, .93; CS, .92; CR, .91; AS, .89. In addition, Gregorc found that the test-retest (from six hours to approximately eight weeks) correlation coefficient ranged from .85-.88 at the level of $p < .001$.

Joniak and Isaksen (1988) examined the relationship to the Kirton's Adaptive-Innovative Inventory (KAI) and the GSD, as well as the internal consistency of the GSD. Kirton's theory of cognitive style advocated bipolar continua with the adaptor and the innovator on the opposite ends (Kirton, 1976). In the decision-making process, the adaptor resorted to traditional or conventional procedures to determine the solution. The innovator tended to redefine the dilemma through a creative means. In two different studies with separate samples of 109 undergraduates and 135 undergraduates, the two tools were administered during two different semesters during 1985, respectively. The correlation between the two tests was distinctively different at the level of p =.002. In both samples, CS and AS scores were negatively related with the KAI total scores, and appeared to be adaptors on the KAI. In contrast, CR and AR scores were positively related to the KAI total scores, and appeared to be innovators, regardless of the ordering perceptive aspect of concrete or abstract.

In further examination of the bipolar dimension, Joniak and Isaksen found that the Pearson Product-Moment Correlation for the pairing of CS-CR and AS-AR demonstrated significance (p = .001), and ranged in value from -.53 to -.64. The interpretation looked at the S-R dimension, which may have been the influential factor. No other pairs demonstrated an acceptable difference. The results of a principle components factor analysis, varimax rotation, of the responses to the 40 items of the GSD, revealed that the

subscales were not factorially pure. Since the factors were not readily interpretable, demonstrating only two to six items per factor, the relationship between factors and styles was not significant. The investigators identified that the discrepancy of their results (alpha coefficients of .23-.66) with Gregorc's (1984a) alpha coefficients of .89-.93 at the $p < .001$ level, may be attributed to the GSD test design. All of the items of each subscale were in the same horizontal row, or the actual number of items may have contributed to the respondent's fatigue or carelessness. The results of their study revealed no change in the alpha coefficient of the KAI, which supported the internal consistency of the KAI. The lack of empirical support for the reliability and validity of the GSD may also be attributed to the four styles, in comparison to the KAI, which purports one continuum.

Due to the inconsistent reliability presented in the literature review, this investigator assessed the internal reliability of the four subscales of the GSD.

GSD Validity. O'Brien (1990) assessed the construct validity of the GSD by using confirmatory factor analysis, LISREL 7, which was purported as the "correct" approach to specifically analyze ordinal variables used in the GSD. This was in comparison to more commonly used factor analysis for interval and ratio measurement scales. Jointly the four cognitive styles provided adequate measurement scales, although individual measures were not acceptable. Results from O'Brien's study consisted of alpha coefficients of .64 for the CS scale, .51 for the AS scale, .61 for the AR scale, and .63

demonstrated interaction between 1) the concrete-sequential (CS) learner with the sensing, intuition and perceptive; 2) the abstract-sequential (AS) learner with extroversion, sensing, thinking; 3) the abstract-random (AR) learner with sensing, thinking, judging, intuition, feeling and perceptive; and 4) the concrete-random (CR) with sensing judging, intuition and perceptive. Measures of the GSD and the MBTI capture the similarities also identified by Borokos et al. (1992).

Procedure

The University of Medicine and Dentistry of New Jersey Institutional Review Board (IRB) provided approval of the research study with exempt status due to the survey research design. (Refer to Appendix A: IRB Application and Appendix B: IRB Approval Letter.)

The investigator contacted the program directors of the three New Jersey Physical Therapy programs, the joint programs of the University of Medicine and Dentistry of New Jersey-Newark Campus, in collaboration with Seton Hall University and Kean College; the University of Medicine and Dentistry of New Jersey-Camden Campus, in collaboration with Rutgers University, as well as the Richard Stockton State College. In collaboration with the program directors and/or faculty, a schedule was developed for the investigator to meet with students from each program who agreed to complete the questionnaire, either before or during class, or during a designated time.

The survey was conducted through in-person scheduled visits to each program. Assembled in groups with each educational institution, students completed the questionnaires including 1) demographic information which consisted of gender, age, ethnicity, and number of years of post-secondary education, 2) preference scales including teaching methods and instructional activities, and 3) the Gregorc Style Delineator (GSD). Students were informed that the half-hour activity was voluntary and were given instructions on how to complete the survey. Upon completion, questionnaires were collected and information was coded and analyzed.

Data Analysis

Statistical analyses were conducted using SPSS Version 9.0 (1999).

Students completed the preference scales, teaching methods and instructional activities, by indicating their associated scores on a Likert-type scale from 1 to 5, with the score of 5 indicating "most preferred" and 1 indicating "least preferred." In addition, the preferences of study settings and study times were part of the questionnaire.

In order to ascertain preferences to the four mediation cognitive styles: concrete-sequential (CR), abstract-sequential (AS), abstract-random (AR), and concrete-random (CR), the cumulative scores, ranging from 27-40, were studied. A strong preference or natural orientation to the qualities describing a particular cognitive style was documented (Gregorc, 1982b). The mediation model evolved by acknowledging the predisposition of "dual"

learning styles, where one indicated two learning style scores greater than 26, although only two research articles reported the "dual" learning styles. After the data were collected and coded, this investigator decided to increase the discrimination of the GSD by using scores greater than 27, which provided a stronger indictor of learning styles and collapsed the data into more meaningful groups (A. Gregorc, personal communication, September 5, 1999).

Descriptive statistics were used to analyze the demographic information, and the student ratings on the teaching methods and instructional activities preference scales. The percentage of occurrence, mean, mode, standard deviation, and the variance of each criterion were computed. The raw scores of the GSD in each learning style were also assessed by the same descriptive analysis. If respondents scored in two learning styles above 27, the dual assignment created another learning style.

The predominant learning style category was cross-tabulated with selected demographics, of age, gender, ethnicity, and years of post-secondary education. Chi-square statistic was computed for each comparison. The alpha level was set at .05.

A principle component analysis of the 14 teaching methods variables and the 20 instructional activities variables was conducted to establish factor scores. After the initial extraction, the factors were subject to orthogonal rotation using the Equamax method. Based on the size of the eigenvalues

and an analysis of the scree test plot, three, four, and five factor solutions were further explored to ascertain the best representation of the data. The criterion of ± 0.5 was used to assign items to a given factor (Weiss, 1970; Comrey, 1973). Based upon the factor loadings of each component, the investigator "labeled" the groupings. Using a second principle component analysis, followed by an Equamax rotation, factor scores were also derived for each respondent for each of the preference scales, teaching methods and instructional activities.

Bivariate Pearson-product moment correlation coefficients were calculated between the respondents' scores on each of the four subsets of GSD scores and each of their four teaching method factors and their four instructional activities factor. The alpha level was set at .05.

An analysis of variance of the factors derived from the principle components analysis was executed to compare the means across groups, and to ascertain any significant differences. The alpha level was set at .05. Since dual styles existed, this was added as an additional learning style.

Chapter IV

RESULTS

Survey Response

The survey population consisted of all 264 physical therapy students enrolled in the physical therapy programs in the State of New Jersey. The survey was conducted through in-person scheduled visits to each program. By arrangement with the program faculties, the survey instrument (refer to Appendix C) was administered to the students who volunteered to complete the questionnaire either before, during, after class, or during a specifically designated time scheduled to complete the questionnaire. Of the 264 students in the population, there were 74 non-respondents who chose not to participate, were absent, or did not adequately provide the essential information or answer the question(s). A total of 190 students (72.3% of the population) participated in the investigation by completing the survey instrument, including demographic information, GSD, and teaching methods and instructional activities preference scales. Missing or incomplete information on the survey disqualified the student as a participant and consequently, decreased the number of students (N) to less than 190.

GSD Reliability

Several studies in the literature review described the reliability of the GSD (Gregorc, 1984a; O'Brien, 1990, O'Brien & Wilkinson, 1992). Gregorc (1984a) obtained alpha coefficients for the four scales in the range of 0.89 to 0.93 ($p < .001$). In addition, Gregorc also identified strong test-retest (from six hours to approximately eight weeks) correlation coefficients ranging from 0.85 to 0.88 ($p < .001$). In contrast, when Joniak and Isaksen (1988) assessed the relationship between Kirton's Adaptive-Innovative Inventory and the GSD, they obtained substantially lower alpha coefficients for the four scales (0.23 to 0.66). The authors identified possible shortcomings in test construction (all subscale items are presented in the same row) or subject fatigue and carelessness as potentially contributing to the low internal reliability of the GSD obtained in their study.

Based upon the different results from previous studies, this investigator analyzed the alpha coefficients of the GSD scales and found the following: Concrete-Sequential (CS) = 0.62, Abstract-Sequential (AS) = 0.54, Abstract-Random (AR) = 0.53 and Concrete-Random (CR) = 0.58, all significant at $p < .001$. In this investigation, the GSD exhibited moderate but satisfactory levels of internal consistency and repeatability.

Respondent Demographics

Of the 190 respondents, 74 (38.9%) were male, and 116 (61.1%) were female. The mean age of the responding students was 25.98 years (N=180,

SD=5.33), with a range of 20 to 53 years. Ten students did not provide their age, thereby decreasing the sample by 10 students. As indicated in Figure 2, the age distribution of the respondents was positively skewed (skewness = +2.18), with a median age of 24 years. Ethnicity was represented as follows: 155 (81.6 %) were Caucasian, 22 (11.6%) were Asian/Pacific Islander, 3 (1.6 %) were Hispanic, 4 (2.1%) were Afro-American, and 6 (3.2%) were classified as Other.

Respondents reported an average of 6.17 years of postsecondary education (N=190, SD=1.84). The average of number of years of full-time college-level study reported was 5.48 (N=189, SD=1.45), with an average of only 0.75 years of part-time study (N=189, SD=1.63) (refer to Table 3 for student profile).

The respondents' program year proved difficult to assess due to the different curricular designs and the different classifications of students among the participating programs. The UMDNJ-Newark Campus Program, in collaboration with Seton Hall University and Kean College, is a three-year curriculum, while the UMDNJ-Camden Campus Program, in collaboration with Rutgers University, and the Stockton State College Program offer two-year curricula. Due to the discrepancy, the data regarding program year were inaccurate, since students enrolled in the two-year programs identified their first year as either year one or year two.

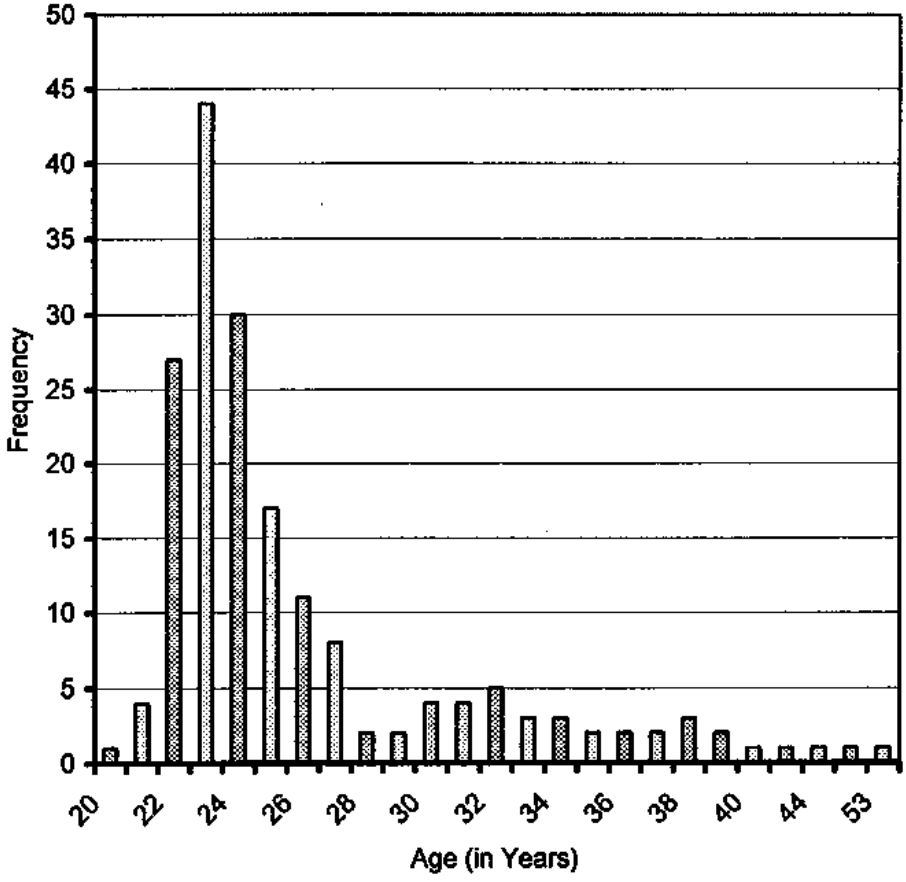


Figure 2

Distribution of Students According to Age

Table 3

Profile of Participating Physical Therapy Students in New Jersey

Variable	Description
Age	Mean age = 25.98 years,
	Age Range = 20-53 years
	(N=180, SD= 5.33)
Gender	Male = 74 (38.9%)
	Female = 116 (61.1%)
Ethnicity	Caucasian = 155 (81.6%)
	Asian/Pacific Islander = 22 (11.6%)
	Hispanic = 3 (1.6%)
	Afro-American = 4 (2.1%)
	Other = 6 (3.2%)
Number of Years of Post-secondary Education	Mean = 6.17 years
Full-time Education	Mean = 5.48 years
Part-time Education	Mean = 0.75 year

Respondent Learning Styles

Distribution in Sample. The first research question asked: *What are the learning style preferences of physical therapy students?*

The original criterion used by Gregorc (1982a) to classify respondents as having a predominant GSD learning style was a score of 27 or higher on a subscale (CS, CR, AS or AR). Based on an initial assessment of the respondent data for this study, with the concurrence of the scale author (Gregorc, personal communication, 1999), the minimal score for learning style delineation for this study was set at 28 (see Methods Section). Thus, students were classified into one of the categorized learning styles if their single highest score was 28 points or higher (out of possible 40) on one specific scale. Table 4 summarizes the distribution of the participants' dominant learning styles according to this classification scheme.

The CS group consisted of 59 (31.1%) students, demonstrating the most students in one "pure" learning style category. The AR category, which included 37 (19.5%) students, represented the second highest number of students in a category. Fifteen students (7.9%) had a predominantly AS style, while only 11 (5.8%) could be categorized as exhibiting the CR style.

Dual Learning Styles. Students who scored 28 or more on two scales were categorized as having a "dual" learning style. Sixty-five of the 190 respondents (34.2%) were so classified, making this the largest learning style group in the sample.

Table 4

Distribution of Participants' Learning Styles

GSD Style	Count	Percent	Cum Percent
Concrete-Sequential (CS)	59	31.1	31.1
Abstract-Random (AR)	37	19.5	58.4
Abstract-Sequential (AS)	15	7.9	38.9
Concrete-Random (CR)	11	5.8	64.2
Dual Learning Style	65	34.2	98.4
Trio Style	2	1.1	99.5
No Preference	1	0.5	
Total	190	100.0	100.0

Within the dual category, six combinations of learning styles were identified: Concrete-Sequential-Abstract-Sequential (CS-AS), Concrete-Sequential-Concrete-Random (CS-CR), Abstract-Sequential-Abstract-Random (AS-AR), Abstract-Sequential-Concrete-Random (AS-CR), Concrete-Sequential-Abstract-Random (CS-AR), and Abstract-Random-Concrete-Random (AR-CR) (Figure 3). The CS-AS and CS-AR groups had the highest frequency at 20 (10.5%) and 19 (10%), respectively. The AR-CR dual group consisted of 11 students (5.8%). One student was considered a "trio" learning style, and one student, who was identified as "no preference", scored less than 28 in all learning style categories.

Demographic Data

The second research question asked: *Do these learning styles correspond to known demographics, such as age, gender, ethnicity, or years of post-secondary education?*

To address this question, predominant learning style category was cross-tabulated with selected demographics, of age, gender, ethnicity, and years of post-secondary education. A Chi-square statistic was computed for each comparison. The alpha level was set at .05.

Age. Students were divided into two age groups: Group I consisted of 75 students with ages ranging from 20–23 years, and Group II consisted of 105 students with ages ranging from 24–53 years. The two groups were established to provide the most equal number of students in each group. Ten

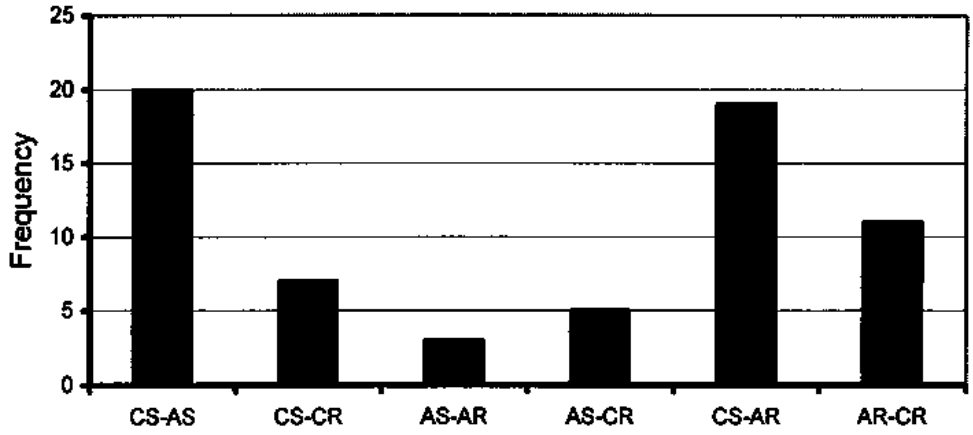


Figure 3

Distribution of "Dual" Learning Styles

students did provide their age. Based on the analysis, there was no significant difference in the observed and expected frequencies of the primary learning style categories (CS, AS, AR, CR) when cross-tabulated with age groups, X^2 (3, N = 115) = 2.967, p = .397.

Gender. In determining the association of primary learning style categories with gender, statistical difference was evident with males with the AS and CR learning styles, X^2 (3, N = 121) = 11.735, p = .008. However, the AS and CR learning styles represent such a small number of students that the significance is limited.

Ethnicity. Students identified their ethnic backgrounds as Caucasian, Asian/Pacific Islander, Hispanic, Afro-American, and Other. When primary learning style category was cross-tabulated with ethnicity, no statistical difference was calculated, X^2 (12, N = 121) = 12.651, p = .395.

Education Level. The level of post-secondary education was designated into two equal groups: Group I (5 years and under), and Group II (6 years and over). Primary learning styles were cross-tabulated with the two groups and yielded no statistical significance, X^2 (3, N = 121) = 3.303, p = .347. In recoding the information to groups, the cell sizes decreased and in the low frequency cells, did not provide the number of observed frequency essential for adequate analysis.

Teaching Methods

Table 5 provides the rank-ordered means and standard deviations for the 14 teaching methods scale items. The four teaching methods ranked highest by the respondents were promoting a positive mood ($\underline{M}$= 4.75); enhancing the class mood ($\underline{M}$ = 4.59); teaching from area of content expertise ($\underline{M}$ = 4.48); and personalizing the class ($\underline{M}$ = 4.42).

Significant bivariate correlations were observed among many of the 14 teaching method variables. For this reason, and in order to achieve a parsimonious understanding of these relationships, a principal components analysis of the 14 teaching method variables was conducted. After initial extraction, the factors were subject to orthogonal rotation using the Equamax method. Based on the size of the eigenvalues and an analysis of the scree test plot, three, four, and five factor solutions were further explored, with the four-factor solution retained as the best representation of the data. In combination, the four retained factors accounted for 50.2% of the common variance for the teaching methods scale.

The criterion of ± 0.5 was used to assign items to a given factor (Weiss, 1970; Comrey, 1973). Using this criterion, none of the teaching methods items loaded on more than one factor, and only one (CAI) did not load on any factor. Table 6 summarizes the loadings for each of the variables on the four factors.

Table 5

Teaching Methods Rank-Ordered by Mean Rating

Teaching Method	Mean (5=high)	SD
Promote a positive mood	4.75	0.49
Enhances the mood of the class	4.59	0.69
Teaches from expertise	4.48	0.74
Personalizes the class	4.42	0.84
Provides long-range planning	4.17	0.85
Enforces orderly classroom and lab	3.90	1.10
Provides manual and project	3.84	0.90
Fosters creative product	3.81	0.93
Insist students think for themselves	3.80	0.88
Uses programmed instruction	3.69	0.94
Guides individual study	3.53	1.07
Employs computer-aided instruction	3.31	1.09
Assigns optional reading	3.04	1.08
Uses trial and error discovery	3.02	1.21

Table 6

Factor Loadings for Teaching Methods Scale Items

	Factor			
	TM-I	TM-II	TM-III	TM-IV
Teaching Method	Collaborative Teaching	Self-Directed Teaching	Detailed Teaching	Structured Teaching
Positive mood	.809			
Mood of class	.786			
Personal class	.729			
Content expert	.519			
Long-range planning	.494			
Individual study		.744		
Creative products		.716		
Think for self		.551		
Trial and error		.548		
Optional reading			.708	
Manuals/projects			.531	
Programmed instruction				.765
Orderly class and lab				.662
CAI				

All factor loadings were positive. For teaching methods, Factor TM-I, which included a positive mood, mood of the class, personalized class, content expertise and long range planning, was labeled "Collaborative Teaching." Factor TM-II, labeled "Self-Directed Teaching", consisted of individual study, creative products, thinking for self, and trial and error. Factor TM-III, which included optional reading and the use of manuals and projects, was labeled "Detailed Teaching." Factor TM-IV, composed of programmed instruction and orderly class and lab, was labeled "Structured Teaching."

Instructional Activities

Table 7 provides the rank-ordered means and standard deviations for the 20 instructional activities scale items. The five instructional activities ranked highest by the respondents were hands-on practice ($\underline{M}$ = 4.73), practical application ($\underline{M}$ = 4.72), demonstrations ($\underline{M}$ = 4.59), and handouts and simulations ($\underline{M}$ = 4.34).

To identify if the 20 instructional activity scale items formed meaningful groups, a second principal components analysis, followed by a Equamax rotation, was performed on these variables.

Based on the size of the resulting eigenvalues and an analysis of the scree test plot, 3, 4 and 5 factor solutions were further explored, with the 4 factor solution retained as the best representation of the data. In combination

Table 7

Instructional Activities Rank-Ordered by Mean Rating

Instructional Activity	Mean	SD
Hands-on Practice	4.73	0.53
Practical Application	4.72	0.56
Demonstrations	4.59	0.63
Handouts	4.34	0.72
Simulations	4.34	0.72
Lecture	4.15	0.74
Critical Issues	4.06	0.87
Mini-Lectures	3.96	0.84
Documented Evidence	3.94	0.89
Personalized Content	3.93	0.87
Group Discussion	3.81	1.03
Experiments	3.65	1.11
Textbooks	3.59	1.07
Individual Work	3.52	0.99
Use of Media	3.51	1.13
Theme Instead of Detail	3.44	1.15
Interactive Video	3.42	1.25
Workbooks	3.35	1.11
Drills	3.21	1.22
Audiotapes	2.47	1.22

the four retained factors accounted for 42.4% of the common variance for the instructional activity scale items.

The criterion of ± 0.5 was used to assign items to a given factor (Weiss, 1970; Comrey, 1973). Using this criterion, none of the instructional activity items loaded on more than one factor; however, four items (Experiments, Mini-lectures, Theme Instead of Detail, Individual Work) did not load on any factor. Table 8 summarizes the loadings for each of the variables on the four factors.

Learning Styles versus Teaching Method and Instructional Activity Preferences

The third research question asked: *Are there logical relationships between the students' learning styles and their preferred teaching methods and instructional activities*?

Correlation of Learning Styles with Preferences

Initially this research question was explored via bivariate correlation analysis between respondents' scores on each of the four Gregorc scales (CS, AS, CR, AR) and their scores on the factors derived from both the teaching methods and instructional activities scales. The alpha level was set at .05.

Table 9 represents the Pearson Product-Moment Correlation coefficients between respondents' Gregorc Learning Style scores and their

Table 8

Factor Loadings for Instructional Activity Scale Items

	Factor			
	IA-I	IA-II	IA-III	IA-IV
Instructional Activity	Naturalistic Learning	Sensory-Driven Learning	Theme-Oriented Learning	Traditional Learning
Hands-On Practice	.701			
Practical Application	.671			
Simulations	.605			
Demonstrations	.575			
Critical Issues	.519			
Use of Media		.699		
Interactive Video		.691		
Audiotapes		.691		
Drills		.529		
Group Discussion			.691	
Workbooks			.684	
Personal Content			.661	
Lecture				.715
Textbooks				.528
Handouts				.513
Documented Evidence				.496

Table 9

Bivariate Pearson Product-Moment Correlation Coefficients

Gregorc Learning Styles Scores versus Teaching Methods (N=186)

		Teaching Method Factors			
		TM-I	TM-II	TM-III	TM-IV
Learning Styles		Collaborative Teaching	Self-Directed Teaching	Detailed Teaching	Structured Teaching
Concrete-Sequential (CS)	r	.040	-.125	-.022	.252**
	p	.589	.089	.770	.001
Abstract-Sequential (AS)	r	-.158*	-.060	.050	.087
	p	.031	.418	.502	.239
Abstract-Random (AR)	r	.156*	-.091	-.044	-.101
	p	.033	.217	.554	.172
Concrete-Random (CR)	r	-.085	.258**	-.013	-.257**
	p	.249	.000	.857	.000

* Correlation is significant at the 0.05 level (2-tailed)

teaching method preferences as measured by the scores derived from each of the four factors constituting that scale.

Based on this analysis, respondents' preferences for Collaborative Teaching (TM-I) demonstrated a significant positive correlation (r = +0.156, p = .033) with their Gregorc Abstract-Random (AR) subscale scores, and a significant negative correlation (r = -0.158, p = .031) with their Gregorc Abstract-Sequential (AS) subscale scores. The strongest positive relationship (r = +0.258, p < .001) was observed between respondents' preferences for Self-Directed Teaching (TM-II) and their Concrete-Random (CR) subscale scores. No significant correlations were observed between any Gregorc learning style subscale and the Detailed Teaching (TM-III) method preferences of the respondents. Respondents' preferences for Structured Teaching (TM-IV) demonstrated a significant positive correlation (r = +0.252, p = .001) with their Gregorc Concrete-Sequential (CS) subscale scores, and a significant negative correlation (r = -0.257, p < .001) with their Concrete-Random (CR) subscale scores.

Table 10 indicates the Pearson product-moment correlation coefficients between respondents' Gregorc Learning Style scores and their instructional activities preferences as measured by the scores derived from each of the four factors constituting that scale.

Based on this analysis, no significant correlations were observed between any Gregorc learning style subscale and respondents' preferences

Table 10

Bivariate Pearson Product-Moment Correlation Coefficients

Gregorc Learning Styles Scores versus Instructional Activities (N=185)

		Instructional Activity Factors			
		IA-I	IA-II	IA-III	IA-IV
Learning Styles		Naturalistic Learning	Sensory-Driven Learning	Theme-Oriented Learning	Traditional Learning
Concrete-Sequential	r	-.108	-.191**	.046	.193**
(CS)	p	.142	.009	.532	.009
Abstract-Sequential	r	.016	-.095	-.073	.169*
(AS)	p	.834	.196	.320	.021
Abstract-Random	r	.044	.105	-.038	-.081
(AR)	p	.551	.156	.609	.271
Concrete-Random	r	.055	.188*	.024	-.288**
(CR)	p	.454	.010	.747	.000

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

for either the Naturalistic Learning (IA-I) or Theme-Oriented (IA-III) instructional activities. Respondents' preferences for Sensory-Driven Learning (IA-II) demonstrated a significant positive correlation (r = +0.188, p = .010) with their Gregorc Concrete-Random (CR) subscale scores, and a significant negative correlation (r = -0.191, p = .009) with their Concrete-Sequential (CS) subscale scores. An opposite pattern was observed in relation to preferences for Traditional Learning (IA-IV); respondents' scores on this factor exhibited a significant negative correlation (r = -0.288, p < .001) with their Concrete-Random (CR) scores, and a significant positive correlation (r = +0.193, p = .009) with their Concrete-Sequential (CS) subscale scores.

Preference Differences by Predominant Learning Style Group

The third research question also provided the basis for the study's major inferential hypothesis: *Students grouped by learning styles differ in their preference for both teaching methods and instructional activities.*

To test this hypothesis, mean scores on the teaching methods and instructional activity scale factors were compared across the five predominant learning styles (CS, CR, AS, AR, DUAL), using a one-way analysis of variance (ANOVA) model. The alpha level was set at .05.

Table 11 summarizes the results of the ANOVA analysis for the difference in respondents' mean teaching method factor scores by predominant learning style group. The ANOVA comparison of teaching

Table 11

Analysis of Variance (ANOVA)

Difference in Respondents' Mean Teaching Method Factor Scores

by Predominant Learning Style Group

Factor		SS	df	MS	F	Sig.
TM-I Collaborative Teaching	Between Groups	5.769	4	1.442	1.468	.214
	Within Groups	174.837	178	0.982		
	Total	180.606	182			
TM-II Self-Directed Teaching	Between Groups	16.429	4	4.107	4.381*	.002
	Within Groups	166.859	178	0.937		
	Total	183.288	182			
TM-III Detailed Teaching	Between Groups	4.327	4	1.082	1.085	.366
	Within Groups	177.506	178	0.997		
	Total	181.833	182			
TM-IV Structured Teaching	Between Groups	15.066	4	3.767	4.071*	.003
	Within Groups	164.670	178	0.925		
	Total	179.736	182			

*significant at the 0.05 level

method preferences by learning style groups did yield significant differences in means scores on the Self-Directed (TM-II) and Structured Teaching (TM-IV) factors

To determine which group means were significantly different on these factors, two Scheffee post-hoc comparisons were conducted ($\alpha = 0.05$). For Self-Directed Teaching (TM-II) means, the CR learning style group ($\underline{M}$ = 0.853; $\underline{SD}$ = 0.63) had significantly higher scores on this factor than the AR group ($\underline{M}$ = -0.327; $\underline{SD}$ = 1.03). The Scheffee post-hoc comparison for Structured Teaching (TM-IV) means revealed that the CS group ($\underline{M}$ = 0.276; $\underline{SD}$ = 0.88) had significantly higher scores on this factor than the CR group ($\underline{M}$ = -0.852; $\underline{SD}$ = 0.61).

Table 12 summarizes the results of the ANOVA analysis for the difference in respondents' mean instructional activity factor scores by predominant learning style group. As is evident, no significant differences were observed in instructional activity factor scores among the five respondent learning style groups.

Preference Differences by Learning Style Dimension

Because so few differences in teaching methods and instructional activity preferences were discerned among the five predominant learning style groups, a decision was made to explore the two bipolar dimensions the Gregorc scale (Concrete versus Abstract; Random versus Sequential). To

Table 12

Analysis of Variance (ANOVA)

Difference in Respondents' Mean Instructional Activities Factor Scores by Predominant Learning Style Group

Factor		SS	df	MS	F	Sig.
IA-I Naturalistic Learning	Between Groups	2.058	4	.514	.503	.733
	Within Groups	180.936	177	1.022		
	Total	182.994	181			
IA-II Sensory-Driven Learning	Between Groups	4.427	4	1.107	1.114	.351
	Within Groups	175.874	177	.994		
	Total	180.301	181			
IA-III Theme-Oriented Learning	Between Groups	4.797	4	1.199	1.204	.311
	Within Groups	176.317	177	.996		
	Total	181.115	181			
IA-IV Traditional Learning	Between Groups	5.766	4	1.442	1.478	.211
	Within Groups	172.592	177	.975		
	Total	178.358	181			

that end, respondents' subscale scores were used to recategorize them as either (1) primarily Concrete (CS or CR) or Abstract (AS or AR) and (2) as primarily Sequential (CS or AS) or Random (CR or AR). Due to the nature of this classification scheme, these two dimensions were not mutually exclusive. For this reason, however, the 'DUAL' group had to be excluded from this analysis.

Independent t-tests were used to determine what differences, if any, existed in the teaching methods and instructional activity preferences of the Concrete versus Abstract and the Random versus Sequential respondent groups ($\alpha = 0.05$). There were 128 respondents classified as either primarily Concrete ($\underline{N} = 76$) or primarily Abstract ($\underline{N} = 52$). Independent t-tests for these groups revealed no significant differences in the respondents' mean scores for either the Teaching Methods or Instructional Activities factors.

There were 148 respondents categorized as primarily Random ($\underline{N} = 57$) or primarily Sequential ($\underline{N} = 91$). Independent t-tests for these two groups on the four Teaching Methods factors revealed significant differences only on Factor TM-IV (Structured Teaching). Respondents categorized as Sequential exhibited a higher mean score on this factor than those in the Random group ($\underline{t} = 2.06$; $\underline{p} = 0.042$).

Independent t-tests for the Random and Sequential groups on the four Instructional Activities factors revealed two areas of significant difference. Respondents categorized as Random exhibited a higher mean score on

Factor IA-II (Sensory-Driven Learning) than those in the Sequential group (t = -2.06; p = 0.041). However, on Factor IA-IV (Traditional Learning), the Random group exhibited a lower mean score than the Sequential group (t = 2.22; p = 0.028). There were no other significant differences in mean scores for the Instructional Activities factors between the Random and Sequential groups.

Chapter V

DISCUSSION AND CONCLUSIONS

Respondent Demographics

The findings indicate that the respondents to this survey were predominantly young Caucasian females, with a history of high academic achievement. In contrast, this profile differs from the physical therapy students described in the mid-1970's (Payton et al., 1979). Over the period of about three decades, the male enrollment has doubled. According to the American Physical Therapy Association (APTA) Biennial Accreditation Report (1998), the student enrollment for the academic year of 1997-1998 revealed 65.5% women and 35.4% men, which is similar to the gender distribution of this sample. The national minority physical therapy student representation is 13.3%, as compared to the 18.8% minority representation reported in this project. The average age of students has increased by four years, which may also be reflective of the entry-level programs progressing to the entry-level masters degree. Current information on the number of years of post-secondary education, and learning styles was not available through the APTA.

Learning Styles

Distribution in Sample. The first research question assesses the learning style preference of physical therapy students. As detailed in Table 3, the CS learning style represents the highest proportion of "singular" learning styles, followed by the AR learning style. The CS student is structured, practical, predictable, and thorough, with low tolerance for ambiguity. This individual is more task-oriented than people-oriented. The AR student is idealistic, people-oriented, creative, and perceptive and is a compulsive learner (Gregorc, 1982a, 1984; Butler, 1988). This pattern of frequency of the CS and AR learning styles, which is followed by the AS and CR learning styles in diminished frequency, is in concert with other health professions, such as dental, dental hygienist, nursing, and physician assistant students (Berlocher & Hendricson, 1985; Rahr et al., 1991; O'Brien and Wilkinson, 1992; Harasym et al., 1995a, 1996). The AS student is logical, analytical, conceptual, and studious, with low tolerance for distractions and is a compulsive scholar. The CR student is inquisitive, independent, with low tolerance for details, and tends to be practical rather than scholarly (Gregorc, 1982a, 1984; Butler, 1988).

If these frequencies represent physical therapy students nationwide, a dilemma exists. Will the current and future student populations, which seem to reflect a high percentage of CS learning styles and consequently,

individuals who gravitate towards intellectual and practical approaches, be able to meet the demands of the ever-changing physical therapy practice of the new millennium? Physical therapy practitioners must be competent in evidence-based practice that requires theoretical frameworks and critical inquiry, characteristics that are more reflective of AS and CR learners, respectively.

Dual Learning Styles. When considering the results in this study, it is important to note that about one-third of the students are classified as a "dual" learning style, designated when two subscales are scored 28 or more. The "dual" learning style describes an individual who is able to comfortably demonstrate the characteristics of each of the learning styles. This is an unexpected result since the high percentage of "dual" learning styles is not well documented in the literature.

Only a few journal articles documented individuals with "dual" learning styles designated by scores of 27 or above on two of the dimensions. The bimodal characteristic is only 13% and 15% of the samples of nursing and dental students, respectively, which is significantly less than the "dual" findings of this study (O'Brien & Wilkinson, 1992; Berlocher & Hendricson, 1985). However, in an unpublished dissertation using an embedded research design, Gaden (1992) reported that 56% of the 147 physical therapy students in four programs revealed "dual" learning styles, using the 27 raw score or above as the criteria. This outcome is closer to the findings of this study and

may be reflective of physical therapy students in general, or the outcomes of the student selection process.

The CS learning style is not only prevalent in the single learning styles, but it is also part of the two most frequently identified "dual" learning styles. In the present study, the CS-AS and the CS-AR contribute to about 21% of the bimodal styles. The "dual" learning style may be attributed to the characteristics of the physical therapy student. With a strong educational background of courses predominantly in the natural sciences and the successful completion of selective admissions criteria to enter the physical therapy program, these graduate students have learned to be adaptive in the learning experiences. As a highly evolved learner, students may have developed multiple accommodating skills to fulfill the varied course requisites (e.g. case studies, problem-based learning, handling labs). In addition, specific to physical therapy education, students learn the relevant science foundation, expanded with clinical application through "doing" and problem solving. The physical therapy knowledge base and clinical skills are outlined in A Normative Model of Physical Therapist Professional Education (1997), and The Guide to Physical Therapist Practice (1999), two documents developed by the American Physical Therapy Association, and essential components of the accreditation process.

The second research question addressed students' learning styles and their associations to known demographic information. According to the

findings, learning styles do not correspond to age, gender, or the number of years of post-secondary education. However, the statistical validity of this finding is suspect due to the large number of cross-tabulated cells with very low frequencies (even after collapsing the data into a smaller number of categories). Consequently, it is recommended that future research employ a larger sample to ensure statistical validity in the cross-tabulation of demographics and learning styles.

Teaching Methods

The results of the ranked averaged means of the teaching methods items indicate that students prefer a supportive, personalized, positive environment. The preference of these teaching methods is also supported by literature. Payton et al. (1979) used the Canfield-Lafferty Learning Styles Inventory and found that physical therapy students prefer to work closely and personally with the instructor. Parallel to these findings, occupational therapy students preferred similar conditions for learning: informal teaching conditions where students had a personal relationship with the instructor and high preference for working for people (Llorens & Adams, 1978, Rogers & Hill, 1980). According to Gregorc (1982a, 1982b), the supportive, personalized, positive environment attracted the individual with an AR learning style, which was the second highest occurring dimension in this study and other disciplines (Berlocher & Hendricson, 1985; Harasym et al., 1995a, 1996).

Principal components analysis of the fourteen teaching method items yielded four factors that made logical sense of the data. In TM-I (Collaborative Teaching), the first three loadings correspond to AR preferences (positive mood, mood of class and personalized class) when using the Gregorc model. This reinforces the selected teaching methods that ranked high. In TM-II (Self-Directed Teaching), three of the four high-ranking loadings correspond with CR preferences (individual study, thinking for self, and trial and error). Both factor loadings detailed in TM-IV (Structured Teaching) described CS preferences (programmed instruction and an orderly class and lab), which demonstrated the need for structure and external direction, in contrast to independent, internal direction.

Prior literature suggested that teaching methods used should be among students' preferences. Student and instructor similarity in learning styles and educational strategies was advocated to promote student motivation and achievement, evidence of effective learning (Gregorc, 1979; Gregorc & Butler, 1984). Two studies (one of which involved physical therapy students), examined the teaching and learning process to ascertain if the teaching methods employed by instructors were the same methods ascribed to the preferred learning styles of teachers and students (Thompson, 1989; Gaden, 1992). The importance of matching the learning preference and personality characteristics in short-term critical nursing preceptor programs was identified for optimal learning during an internship (Carroll, 1992). The

"match" between the student's cognitive style and the instructor fostered the educational process because the ordering or categorizing of the course content and learning experiences were similar, promoting effective communication and problem solving. However, students also need to be "adaptive" and to develop "coping" skills in order to benefit from all learning experiences and to meet the challenges in an eclectic manner, particularly in the ever-changing fields of technology and health care. According to learning theorists (Gregorc, 1982a, 1982b; Claxton & Murrell, 1987; Kolb, 1971; Jung, 1961), learning styles are innate and each individual demonstrates natural predisposition to specific styles. Student's preferences in certain teaching methods and instructional activities can be influenced by prior learning experiences, even if they are not ascribed to the student's learning style. Motivation to succeed and academic achievement may contribute to the student learning "outside" of his or her own preference in teaching methods and instructional activities.

Learning "outside" of one's preferences in teaching methods and instructional activities may be evident with students who are enrolled in a physical therapy program that employ problem-based learning (PBL), which is considered the most significant curricular-design innovation in professional education (Miller, 1999; Kaufman et al., 1997; Hay, 1996). The PBL approach focuses on the processes of learning, as well as the knowledge base and content, and promotes independent, self-directed learning. In the PBL design,

students are responsible to solve case problems through small group work, in order to reach a consensus as to the best solution. Since current physical therapy practice emphasizes evidence-based practice, the PBL model, in part or in whole, empowers students to rely more on the knowledge base of published clinical evidence and critical inquiry abilities.

This study determined that current physical therapy students are predominantly CS learners. They have identified the components of the PBL model as the least preferred teaching methods, which were in ranked-order by mean rating: guides individual study, employs computer-aided instruction, assigns optional reading, and uses trial and error discovery. Evidence-based physical therapy requires clinicians to function independently through individual study and optional reading in order to develop an accurate updated knowledge base of the clinical sciences and clinical application. The use of trial and error fosters the skills of problem-based learning and enables the clinician to establish appropriate skills for client management.

Computer-aided instruction (CAI) represents the growing presence of modern technology in education and clinical-decision making, consequently, an essential skill to demonstrate (Wynn, 1998; Boucher et al., 1999). CAI is the only teaching method scale item that did not load on any factors in the principle component analysis. This may be the least preferred due to minimal exposure to CAI throughout students' academic tenure. However, this has become an innovative teaching method in physical therapy education. Faculty

at Medical College of Ohio have developed the Center for Creative Instruction in 1993 to support and promote the institution's academic mission--to develop technology that facilitates learning anytime and anywhere, as well as to assist educators in exploring technology for use to improve student learning (Wynn, 1998). The use of CAI has grown rapidly with the development of several interactive CD-ROM programs applicable to physical therapy education. At the Southwest Texas State University, faculty compared the effectiveness of CAI to teach the anatomy, biomechanics, and pathomechanics of the temporomandibular joint (TMJ) (Boucher et al., 1999). There was no significant difference between pretest and posttest scores of students who were taught by lecture and students who were taught by CAI. This study demonstrated that the use of traditional lecture and lecture supported by CAI were effective means of teaching information associated to the TMJ.

Technology has provided the infinite possibilities for student learning, and complements the instructor's personal assets in teaching (Wynn, 1998). For example, students can access professional from the internet, and at some institutions course information in an asynchronous manner, at anytime and at any location where a computer is available. Students can "match" the best time of day and environment to study with their learning styles. In addition, technology fosters communication, and students and instructors can customize their communication to meet the audiences' learning style. Technology serves as a catalyst to life-long learning, an essential

professional behavior for all practicing physical therapists to provide cutting-edge services as a clinician, consultant, instructor, and researcher.

Therefore, although it is important to "match" the preferred learning styles in the professional curriculum to foster positive learning, students must be flexible and develop "adaptive" strategies to learn using strategies outside their preferences in order to meet the demands of the challenging environment. In physical therapy education, the PBL model and CAI have fostered independent, self-directed learning. Understanding the rationale of using the least preferred teaching methods may increase student learning, in particular when learning experiences demand the student to learn "outside" of his/her own preferences. The CS learner, which is the predominant learner in this study, is requested to learn in a manner that is typically more characteristic of a CR learner, for example, the use of CAI. Increased exposure to the "least preferred" methods over time may foster the CS learner to "adapt" and to employ effective strategies in the use of the "least preferred" methods. Moreover, this eclectic approach provides opportunities to simulate learning experiences that may be the preferences of their clientele in the practice setting, thus, enhancing their abilities to provide improved physical therapy services through instruction congruent with the client's preferences.

Instructional Activities

From the results, the ranked averaged means of the instructional activities point to respondents who prefer a practical orientation, with the desire to be active learners and participate in the learning by "doing". These characteristics are in concert with the Gregorc CS learning style, the predominant dimension in both the single and "dual" learning styles. In using the Learning Style Inventory during the academic year 1975-76, physical therapy students have indicated a high preference to learn by direct experience, and to have coursework that is logical and clearly organized, with specific details given for assignments and requirements (Payton et al., 1979). They prefer to learn by listening. Furthermore, this sample is not strongly inclined to reading, act independently, work alone, or compete with others, nor is there a desire for the teacher to be an authority figure. The described profile of the CS learner represents the majority of physical therapy students in the past and in this study.

As detailed in the findings, the factor analysis of the 20 instructional activities items identified four components that explained the majority of this scale's variance. IA-I (Naturalistic Learning) reflected Gregorc's CS preferences as the top two loadings as well as the fourth loading (hands-on practice, practical application, and demonstrations). The third and fifth loadings represented CR preferences (simulations and critical issues). The only other pattern worth mentioning is IA-IV (Traditional Learning) where all of

the loadings were categorized as AS preferences (lecture, textbooks, handouts, and documented evidence).

Although students' indicate specific preferences, faculty should not eliminate instructional activities that are identified as the least preferred. Careful scrutiny of the functional skills students require to practice as a professional clinician should be considered in the overall educational experience. The least preferred instructional activities rank-ordered by mean ratings are: interactive video, workbooks, drills, and audiotapes. The workbooks and drills represent traditional means for learning, and perhaps, too time consuming for the "strategic" learner. However, these activities can still serve as effective tool to learn. The interactive video, which may consist of creative repetition and problem solving, is an integral avenue for futuristic learning through the use of technology and students need to develop skills to benefit from this growing instructional activity. Although the use of audiotapes in the classroom setting may be an "inactive" experience, it is an excellent means to learn individually since it is a self-paced, non-visual means to receive and reflect upon information, requiring an overt action (Whitney & Caplan, 1987). The use of audiotapes can be managed easily while driving in the car. All of the instructional activity scale items demonstrate acceptable factor loadings in the four-factor principle components analysis. The "adaptive" learner develops multi-faceted skills to learn and although preferences are identified, strategic skills are essential to meet the challenges

of a fast-paced environment and to empower the clientele to learn in their natural ways, which may or may not match the attending physical therapist's preferences.

Learning Styles versus Teaching Method and Instructional Activity Preferences

The third research question ascertains whether significant differences exist between students' grouped by learning styles and their preferences for both teaching methods and instructional activities. Logical relationships between learning styles and preferences are not supported by the results of either the Pearson product-moment correlation (see Tables 9 and 10) or the ANOVA (see Tables 11 and 12). The latter statistical analysis revealed minimal difference between or among the learning style groups, making it difficult to validate the Gregorc model in entirety.

Past research has raised some conflicting results. A subgroup of 35 female physical therapy students indicated that they preferred learning that is tangible, specific, and laden with general principles and concepts (Rezler & French, 1975; Rezler & Rezmovic, 1981). The predominant personality type was the ESTJ (extrovert-sensing-thinking-judgment). This type describes an individual who attends to the outer world of people and things in action, and tends to be realistic practical and observant with a focus to analyze, weigh the facts, and be objective. Moreover, this type prefers to live in a planned, decided, orderly way. Studies have indicated that the preference in the

personality types of sensing and judging are related to the Gregorc CS scale; feeling and perceptive preferences to AR; and intuition and perceptive preferences to CR (Drummond & Stoddard, 1992; Borokos et al., 1992; Harasym et al., 1995a, 1996). However, in another investigation, the association of learning styles was not evident, nor are there any significant differences between learning styles and preferences for small group case discussion and lecture format using the Learning Style Inventory (Fox, 1984).

In regard to the association of Gregorc learning styles with the teaching methods and instructional activities factors, only a few significant relationships were found. AR preferences, in contrast to AS preferences, were associated with the component, TM I: Collaborative Teaching (positive mood, mood of class, personalized class, content expert). In accordance to the GSD model, the first three items were listed as AR preferences. The CR preferences were strongly related to the TM II: Self-Directed Teaching methods (individual study, creative products, think for self, trial and error), which were also included in the CR profile delineated by Gregorc. CS preferences were positively associated to TM IV: Structured Teaching (trial and error, orderly class and lab), and negatively associated to CR preferences, which consisted of independent learning, thinking for one self, trial and error. It is interesting to note that the first and third comparisons demonstrated the identical abstract or concrete perception dimension; however, these comparisons demonstrated significant inverse correlation of

the bipolar continuum order dimension, sequential and random. In terms of the instructional activities, CR preferences were evident for IA II: Sensory-Driven Learning (use of media, interactive video, audiotapes, drills), in contrast to the significant inverse correlation with CS preferences. Another inverse relationship was the CS preference for IA-IV: Traditional Learning (lecture, textbooks, handouts, documented evidence), in comparison to the CR learner. Although the instructional activities of Traditional Learning was characteristic of the AS learner in the GSD model, perhaps, the bipolar dimension of ordering (sequential or random) was more indicative of student preferences rather than the construct of learning styles proposed by the GSD model.

However, even correlations that achieved statistical significance as described above were of little practical importance. With all significant r^2 values less than 0.10, only a small fraction of the variation in the teaching method and instructional activity preferences of these respondents was explained by their GSD scores. Therefore, it is fair to conclude that, among members of this sample, the GSD is not a useful tool for predicting teaching method or instructional activity preference. Whether this lack of association is due to inherent limitation in the Gregorc model, validity of the teaching method or instructional activity scales, or the unique characteristics of the population sampled is unclear. The latter explanation is at least plausible,

given the unexpected high proportion of respondents exhibiting the "dual" learning styles profile.

These conclusions are similar to the study by Carrier et al. (1982) who assessed the relationship of learning styles to preferences for instructional activities of dental hygiene students using the Kolb Learning Style Inventory and the Instructional Activities Rating Scale. The factor analysis of the 13 instructional activity items produced three factors labeled: traditional classroom activities, self-instructional methods, and interpersonal, group-oriented activities. Using additional analyses, the findings noted that divergers (similar to Gregorc's CS learning style) preferred interpersonal, group-oriented activities.

The results of the ANOVA analysis confirmed only two significant differences in the respondents' mean teaching method factor scores by three of the five predominant learning style groups, consisting of the GSD learning styles (CS, AR, AS, CR), as well as the "dual" group. The findings of the Scheffee post-hoc comparison pointed to the CR students, over the AR students, as having a predilection for the items listed under TM-II: Self-Directed Teaching (individual study, creative products, think for self, trial and error). The first, third and fourth items were designated characteristics of the CR learner in the Gregorc model. The second item was listed as a quality of the AR learner, however, in creating products, an individual must "invent new ways" which is demonstrated by CR learners. These findings are further

supported by the strongest positive significant relationship observed between respondents' preferences for Self-Directed Teaching and their CR subscale scores. Therefore, the preference of CR learners for teaching methods in TM-II: Self-Directed Learning is partially supported by the results of the ANOVA, and the bivariate Pearson product-moment correlation, and is in general agreement with the theoretical framework of the GSD CR learner.

The second major result reveals that CS students, over the CR group, demonstrate a significant preference for the activities listed under TM-IV: Structured Teaching (programmed instruction, orderly class and lab). Both of these items are characteristic of the CS learner as delineated by Gregorc. These findings of CS preferences for Structured Teaching Methods are further confirmed by the significant positive correlation of the CS subscale scores, and the significant negative correlation of the CR subscale scores. The preferences of the CS learner are partially supported by the results of the ANOVA and the bivariate Pearson product-moment correlation, and are in concert with the CS learner profile as advocated by Gregorc. However, it is interesting to note that the instructional activities factor scores does not reveal any statistical difference when compared to the five learning styles.

Preference Differences by Learning Styles Dimension: Sequential versus Random

Since there was little support of the primary research hypothesis, a decision was made to explore whether respondents classified on the

dichotomous poles of the two Gregorc dimensions demonstrated significant differences in their teaching method or instructional activity preferences. The abstract versus concrete continuum addresses the differences in perceiving information, with and without external stimuli. The sequencing versus random continuum compares the ability to organize data in a linear fashion with precise, progressive, logical communication, in contrast to random processing of information, which uses an interwoven pattern of information, allowing one to address diverse pieces of information simultaneously.

An independent sample t-test reveals no factor score differences between the students categorized as concrete learners and those categorized as abstract learners. However, three significant differences arise between the sequential and random dimensions, one for teaching methods and two for instructional activities. For teaching methods, TM-IV (Structured Teaching) denotes that the sequential factor score is greater than the random. This outcome may be supported by the fact that sequential learners do gravitate to the teaching methods listed under Structured Teaching, such as programmed instruction, and an orderly class and lab.

For instructional activities, IA-II (Sensory-Driven Learning) revealed that the mean of the group categorized as random learners is greater than the mean of the group categorized as sequential learners. In addition, IA-IV (Traditional Learning) depicted the mean of the group designated as sequential learners greater than the mean of the group designated as

random learners. These findings are supported by the fact that random learners seek the activities listed in Sensory-Driven Learning, including use of media, interactive video, audiotapes, and lastly, drills, in the sense that this allows for trial and error discovery and probing questions. On the other hand, Traditional Learning is the environment that sequential learners feel more empowered to learn.

"Adaptive" Learning Styles Throughout Education

As students enter the professional phase of their education, they move from primarily group didactic classes to individualized learning experiences. Although the teacher-structured instruction is the typical mode of delivery in education, there is increased independence in learning styles at the conclusion of health professions education, in particular, physical therapist education (Rezler & French, 1975). Occupational therapy students prefer learning styles that include teacher-structured, concrete characteristics. However, there was a higher preference for the abstract mode primarily by the entry-level masters occupational therapy students and for students identified as high achievers (Llorens & Adams, 1978, Rogers & Hill, 1980).

In contrast, dental students' preference for CS increased significantly as they progressed toward graduation, alluding to the influence of institutional learning environment. This reinforces students' initial predisposition of CS in the 4-year longitudinal analysis (Hendricson et al., 1987). Students are confronted with new and different learning experiences where students have

to think and response spontaneously, as evidenced by a lower percent of CS scores and higher percent of dual LS during clinical internships. This is evident in the relationship between occupational therapy student learning styles and clinic performance, where significant correlations between logical, sequential learning styles and clinical performance in physical disabilities are produced, however, inversely related to clinical performance in mental health (Stafford, 1986).

The bipolar dimensions of sequential versus random is also supported by research (Joniak & Isaksen, 1988; Harasym et al. 1995a, 1996). In two studies using factor analysis, Harasym et al. (1995a, 1996) concludes that CS-CR and AS-AR reveal the mediation ability of ordering according to the two bipolar scales, sequential and random, irrespective of the concrete or abstract dimensions. In assessing the construct validation of the GSD through confirmatory factor analysis using LISREL 7, O'Brien (1990) also presents findings more reflective of the bipolar continuum of sequence-random. It is unclear whether this is due to inherent limitation in the Gregorc model, or the unique characteristics of the population sampled. The latter explanation is at least plausible, given the unexpected high proportion of respondents exhibiting the "dual" learning styles profile.

CHAPTER VI

SUMMARY

Given that physical therapy programs nationwide have similar stringent admission standards, emphasizing high academic achievement, it is probable that New Jersey physical therapy students studied here are representative of physical therapy students nationally. Among the member of this sample, the hypothesized relationships between learning styles and preferences in teaching methods and instructional activities are only partially supported. Students grouped by learning styles do not differ significantly in their preference for teaching methods and/or instructional activities. The relationships depicted are not strong in terms of predictability, therefore, the GSD is limited in utility in predicting the teaching methods and instructional activities in relation to the physical therapy students' learning styles.

The observed failure of the Gregorc model to help predict students' preferences for teaching methods and instructional activities may be attributed to a number of reasons. Prior studies have identified two weaknesses in the test format. Students' adaptive abilities may be the result of "dual" learning styles and the highly competent student sample. The selection process is another source of influence where physical therapy

applicants may be chosen to ensure that they possess qualities that are similar to faculty personalities.

The system of evaluation, a component of the institutional effects, may be the "single most powerful factor influencing student's learning style". (Hendricson et al.,1987, p.176). In addition to teaching methods, other influential factors that can dramatically affect learning style are the dominant educational approach of faculty, course work demands, the nature of the subject, and changes in the learning environment (didactic courses to patient care clinical affiliations). Students also analyze the prevailing teaching/testing system, in order to take calculated steps to reach their goal of the highest possible grade using a trade-off of study time and effort. This strategic learner has developed a system appraisal to adapt to changes in faculty teaching and in student evaluation.

One can speculate that despite the partial support of the findings, an effective learning environment may require a "match" of learning styles between the student and instructor/peer to promote motivation and student achievement. The instructor must self-assess and learn how to diversify their teaching methods and instructional activities to address the varied learning styles in the class, lab, or clinical affiliation. Understanding one's own learning styles can enhance communication with "unmatched" learning styles, in particular between students and instructor. Moreover, faculty has the option to select "mismatched" teaching methods and/or instructional activities to

further expand students' adaptive skills and "coping" strategies essential to learning. In addition, faculty will "match" students' learning styles that do not occur frequently, providing them with learning opportunities that are natural, especially for the infrequent learning styles. In the role of the practicing physical therapist, the use of learning styles to augment communication can also enhance the relationship of the physical therapist and the client.

In conclusion, there are three competing speculations as to the results of this research project. First, the Gregorc Style Delineator is only partially valid as originally postulated, although some relationships are consistent, such as the bipolar dimensions of sequential and random. Secondly, it is possible that the questionnaire, which consists of preferences in teaching methods and instructional activities scales, may not be valid. Lastly, the concept of the "adaptive" learner does warrant serious attention, especially in light of the unexpected number of dual learning styles. This is a legitimate alternative explanation for the outcomes of this study. The physical therapy students sampled demonstrated a high level of successful post-secondary education with learning experiences in diverse environments. Therefore, these students may demonstrate less inclination to one concentrated learning style.

Further research is warranted, with larger sample sizes, to investigate the development of learning styles in longitudinal studies. In addition, investigations should focus on the relationships of learning styles and the

educational process. It is important to explore the relationships of learning styles of student and practicing physical therapists and education, which fosters professional growth, knowledge, and skills essential in the ever-changing health care arena.

Recommendations for Further Study

1. Test the statistical validity of the Gregorc Style Delineator in regards to the purported learning styles and the bipolar dimensions of sequential-random.
2. Survey students in physical therapy education in the United States to ascertain the learning styles profile, including the dual learning style, and any relationships with demographic information, as well as teaching methods and instructional activities in a longitudinal study.
3. Determine the "adaptive" strategies of students with "dual" learning styles in a longitudinal study.
4. Investigate current evaluation systems, including the course grade achievement, used in physical therapy education and its influence on students' learning styles.
5. Compare the different learning environments in physical therapy education (traditional classroom, lab, problem-based learning, clinical affiliation) and its influence on students' learning styles.

6. Explore the selection process used in physical therapy education and its impact on the overall student body learning style profile when compared to faculty learning style profile.
7. Assess the effectiveness of student learning and the "match" or "mismatch" of student/instructor learning styles.
8. Study the students' ability to use their learning styles profile in the provisions of effective interaction and service delivery with clients.
9. Ascertain whether high frequencies of single or "dual" CS and AR student learning styles create "gaps" that has limited the physical therapy profession, such as limited number of researchers (AS) or visionaries (CR).
10. Investigate the "match" of students' learning styles and preceptors in clinical education.

References

American Physical Therapy Association (1998). Biennial accreditation report. Alexandria, VA: Author.

American Physical Therapy Association (1997). A normative model of physical therapist professional education: Version 97. Alexandria, VA: Author.

American Physical Therapy Association (1999). The guide to physical therapist practice. Alexandria, VA: Author.

Berlocher, W. & Hendricson, W. (1985). Faculty learning styles. Journal of Dental Education, 49, 684-688.

Boucher, B. & Hunter, D. (1999). The effectiveness of computer-assisted instruction in teaching biomechanics of the temporomandibular joint. Journal of Physical Therapy Education, 13, 47-51.

Bokoros, M.A., Goldstein, M.B. & Sweeney, M.M. (1992). Common factors in five measures of cognitive style. Current Psychology: Research and Reviews, 11, 99-109.

Butler, K. (1988). Learning styles. Learning, 88, 30-34.

Carrier, C., Newell, K., & Lange, A. (1982). Relationship of learning styles to preferences for instructional activities. Journal of Dental Education, 46, 652-656.

Carroll, P. (1992). Using personality styles to enhance preceptor programs. Dimensions of Critical Care Nursing, 11, 114-118.

Carroll, P. (1991). Using multiple teaching techniques in a continuing education offering. Focus on Critical Care, 18, 502-505.

Claxton, C. & Murrell, P. (1987). Learning styles: Implications for improving educational practices. ASHE-ERIC Higher Education Report No. 4.

Comrey, A. (1973). A first course in factor analysis. New York: Academic Press.

Drummond, R. & Stoddard, A. (1992). Learning style and personality type. Perceptual and Motor Skills, 75, 99-104.

Dunn, R., Deckinger, E., Withers, P., & Katzenstein, H. (1990). Should college students be taught how to do homework? The effects of studying marketing through individual perceptual strengths. Illinois School Research and Development Journal, 26, 96-112.

Fox, R.D. (1984). Learning styles and instructional preferences in continuing education for health professionals: A validity study of the LSI. Adult Education Quarterly, 35, 72-85.

Gaden, K. (1992). Inclusion of Gregorc's mind styles concepts in physical therapy curriculum and instruction in selected baccalaureate and post-baccalaureate programs. Unpublished doctoral dissertation, Andrews University, Michigan.

Ginter, E., Brown, S., Scalise, J., & Ripley, W. (1989). Perceptual learning styles: Their link to academic performance, sex, age, and academic standing. Perceptual and Motor Skills, 68, 1091-1094.

Gregorc, A. (1979). Learning and teaching styles: Their nature and effects. In Student Learning Styles: Reston, VA: National Association of Secondary School Principals, p. 19-26.

Gregorc, A.F. (1982a). Gregorc style delineator. Maynard, MA: Gabriel Systems, Inc.

Gregorc, A.F. (1982b). An adult's guide to style. Maynard, MA: Gabriel Systems, Inc.

Gregorc, A.F. (1984a). Gregorc style delineator: Development, technical and administration manual. Maynard, MA: Gabriel Systems, Inc.

Gregorc, A. (1984b). Style as a symptom: A phenomenological perspective. Theory into Practice, 23, 51-55.

Gregorc, A.F. & Butler, K.A. (1984). Learning is a matter of style. Vocational Education, 59, 27-29.

Harasym, P., Leong, E. & Juschka, B. (1996). Relationship between Myers-Briggs Type Indicator and Gregorc Style Delineator. Perceptual Motor Skills, 82, 1203-10.

Harasym, P., Leong, E., Lucier, G. & Lorsheider, F. (1995). Gregorc learning styles and achievement in Anatomy and Physiology. Advances in Physiology Education, 13, 56-58.

Harasym, P., Leong, E., Juschka, B., Lucier, G. & Lorsheider, F. (1995). Myer Briggs psychological type and achievement in Anatomy and Physiology, Advances in Physiology Education, 13, 61-65.

Hay, J.A. (1996). An examination of a tutor evaluation form for problem-based learning curricula in physical therapy and occupational therapy. Journal of Physical Therapy Education, 10, 22-25.

Hendricson, W., Berlocher, W., & Herbert, R. (1987). A four-year longitudinal study of dental student learning styles. Journal of Dental Education, 51, 175-181.

Jung, C. (1961). Psychological types. In The collected works of C.G. Jung. Vol. 4, Princeton, NJ, Princeton University Press. (Originally published in 1913).

Joniak, A.J. & Isaksen, S.G. (1988). The Gregorc style delineator: Internal consistency and its relationship to Kirton's adaptive-innovative distinction. Education and Psychological Measurement, 48, 1043-1049.

Kaufman, R.R., Portney, L.G. & Jette, D. (1997). Clinical performance of physical therapy students in traditional and problem-based curricula. Journal of Physical Therapy Education, 11, 26-31.

Kirton, M.J. (1976). Adaptors and innovators: A description and measure. Journal of Applied Psychology, 61, 622-629.

Kolb, D.A. (1984). Experiential learning. Englewood Cliffs, NJ: Prentice Hall.

Llorens, L. & Adams, S. (1978). Learning style preferences in occupational therapy students. American Journal of Occupational Therapy, 32, 25-27.

Merritt, S.L. (1983). Learning style preferences of baccalaureate nursing students. Nursing Research, 32, 367-372.

Miller, P.J. (1999). The agreement of peer assessment and self-assessment of learning processes in problem-based learning. Journal of Physical Therapy Education, 13, 26-30.

Nelson, B., Dunn, R., Griggs, S., Primavera, L., Fitzpatrick, M., Bacilious, Z. & Miller, R. (1993). Effects of learning style intervention on

college students' retention and achievement. Journal of College Student Development, 34, 364-369.

O'Brien, T.P. (1990) Construct validation of the Gregorc style delineator: An application of LISREL 7. Educational and Psychological Measurement, 50, 631-636.

O'Brien, T.P. (1991). Relationships among selected characteristics of college students and cognitive style preferences. College Students Journal, 25, 495-500.

O'Brien, T.P. (1994). Cognitive learning styles and academic achievement in secondary education. Journal of Research and Development in Education, 28, 11-21.

O'Brien, T.P. & Wilkinson, N.C. (1992). Cognitive styles and performance on the National Council of State Boards of Nursing Licensure Examination. College Student Journal, 26, 156-166.

Payton, O., Huetter, A., & McDonald, M. (1979). Learning style preferences: Physical therapy students in the United States. Physical Therapy, 52, 147-152.

Payton, O., Huetter, A., McDonald, M. & Hirt, S. (1980). Instructional style preference: Physical therapy faculty members in the United States. Physical Therapy, 60, 1277-1281.

Rahr, R., Schmalz, G., Blessing, D., and Allen, R. (1991). Learning styles and environmental preferences of PAs. Journal of the American Academy of Physician Assistants, 4, 351-355.

Rezler, A., & French, R. (1975). Personality types and learning preferences of students in six allied health profession. Journal of Allied Health, 10, 28-34.

Rezler, A. & Rezmovic, V. (1981). The learning preference inventory. Journal of Allied Health, 10, 28-34.

Rogers, J. & Hill, D. (1980). Learning style preferences of bachelor's and Master's students in occupational therapy. American Journal of Occupational Therapy, 34, 789-793.

SPSS (Version 9.0). (1999). Chicago, IL: SPSS Inc.

Stafford, E.M. (1986). Relationship between occupational therapy students learning styles and clinic performance. American Journal of Occupational Therapy, 40, 34-39.

Thompson, M.J. (1989). Validation of the Gregorc learning style model. Occupational Education Forum, 18, 27-37.

Weiss, D.J. (1970). Factor analysis and counseling research. Journal of Counseling Psychologist, 17, 477-485.

Whitney, M. & Caplan, R. (1987). Learning styles and instructional preferences of family practice physicians. Journal of Medical Education, 53, 684-683.

Witkin, H., Moore, C., Oltman, P., Goodenough, D., Friedman, D., Owen, D. & Raskin, E. (1977). Role of the field-dependent and field-independent cognitive styles in academic evolution: A longitudinal study. Journal of Educational Psychology, 69, 197-211.

Wynn, K.E. (1998). Medical College of Ohio: Learning the art of healing through technology. Physical Therapy Magazine, 6, 40-44.

Appendix A

IRB Application

UNIVERSITY OF MEDICINE AND DENTISTRY OF NEW JERSEY - SCHOOL OF HEALTH RELATED PROFESSIONS

1. *Date:* August 11, 1999 *CRIR #*

(Leave blank)

2. *Title of Research Project: (Title must match your grant)*

Relationship of Learning Styles to Preferences for Teaching Methods and Instructional Activities

3. *Sponsor of this Research Project:*

Sponsor Protocol #: (attach 3 copies)

Is this a Federally sponsored project? *( ) Yes* *(X) No*

Has funding been requested? *( ) Yes* *(X) No*

What is the source of the funding request?

4. *Principal Investigator* *Department/Address*

Valerie G. Olson, M.S., P.T. *34 Emma Place, Clifton, New Jersey 07013*

Telephone /Fax/e-mail

(973) 777-3834 *Fax (973)458-0933* *e-mail Dyn.therapy.com@juno.com*

Co-Investigator(s) *Department(s)/Addresses*

Telephone/ Fax(s)/e-mail

5. *This Protocol is to be considered for (check only one box):*

( )Full Review *( )Expedited Review*_____* *(X)Exempt Review**

Appendix A

IRB Application

- *cite specific paragraph from Federal Guidelines (attached)*

Code of Federal Regulations; Title 45: Public Welfare; Part 46: Protection of Human Subjects

Exempt Activities Paragraph 46.101

(1) Research conducted in established or commonly accepted educational settings, involving normal education practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods, unless (a) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (b) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation

(2) Research involving the use of education test (cognitive, aptitude, achievement), survey procedures, interview procedures or observation of public behavior,

6. The proposed research will be carried out in cooperation with the following institution(s):

UMDNJ/SHRP Physical Therapy Program, Newark, New Jersey

UMDNJ/Rutgers Physical Therapy Program, Camden, New Jersey

7. Categories of Human Subjects to be studied in this protocol:

voluntary physical therapy students in the typical student body of each class

Proposed Age Group of Subjects(range): 22-40 *Proposed # of Subjects: about 200*

Yes	No	Yes	No	Yes	No
( )	(X) Minors	( )	(X) Abortuses	( )	(X) Non-English Speaking
( )	(X) Prisoners	( )	(X) Fetuses	( )	(X) Mentally/Physically Challenged
(X)	( ) Minorities	(X)	( ) Women	( )	(X) Pregnant/Lactating Women

8. ***Conflict of Interest Statement:***

Do any of the investigators have a direct or indirect personal financial interest or advisory relationship to the sponsor, manufacturer, or to the owner of the test article?

Yes ( ) No (X) Not Applicable ( )

9. ***Type of Research Activity:***

( ) Clinical Research ( ) Clinical Service (X) Behavioral Research ( ) Basic Science

Yes No

(X) ( )At what location will this research be conducted? As stated in #6

Name_UMDNJ Physical therapy programs Location _Newark and Rutgers, New Jersey

( ) (X)Is this an FDA Clinical Drug/Device Trial? ( )Yes ( )No

Is this Clinical Trial a: Phase I, Phase II, Phase III circle all that apply)

Appendix A

IRB Application

( ) (x)Will radioisotopes be given? If yes, attach on a separate sheet a list of type and dose given.

( ) (x)Has this application been submitted to the Radiation Safety Committee?

( ) (x)Will a placebo be used in this study?

( ) (x)Will a subject control group be used?

If yes, (describe source, number, sex, age and special characteristics, if any)

Signatures:

Investigator Assurance:

I agree to accept responsibility for the scientific conduct of the protocol and to comply with Federal, State, and SHRP policies relative to the protection of the rights and welfare of human subjects. I will submit to the CRIR for review any changes in the protocol prior to its implementation. I also agree to provide the required annual progress report and final report at the end of the study if this application is approved.

Valerie K Olson

Principal Investigator (per signature not acceptable)

Co-Investigator (per signature not acceptable)

Co-Investigator (per signature not acceptable)

Co-Investigator (per signature not acceptable)

COMMITTEE

Department Chair Approval:

I have reviewed this protocol and approve its submission to the CRIR

Craig L Scanlan

COMMITTEE

Department Chair (per signature not acceptable)

Department Chair (per signature not acceptable)

Department Chair (per signature not acceptable)

Department Chair (per signature not acceptable)

(If additional signatures are required, use an additional page)

Appendix A

IRB Application

( ) (X)Will an Investigational New Drug/Device be used? If yes, IND#/IDE#

( ) (X)Is the sponsor the holder of the IND/IDE?

( ) (X)Will an approved drug for "non-FDA approved" be used?

( ) (X)Will fetal tissue be used?

( ) (X)Will surgical or autopsy tissue be used?

( ) (X)Will "discard specimens" be used? If yes, disclose source:_____

( ) (X)Will there be an advertisement for subject recruitment?

If yes, it must also be submitted for approval.

(X) ( )Is there a survey/questionnaire? If yes, attach document(s)

( ) (X)Will data banks, data archives or medical record be used?

( ) (X)Will there be filming or video recording of subjects?

( ) (X)Will there be audio or voice recording of subjects?

( ) (X)Will there be a subject inducement/payment? If yes, dollar($) amount:

( ) (X)Will radioisotopes be given? If yes, attach on a separate sheet a list of type and dose given.

( ) (X)Has this application been submitted to the Radiation Safety Committee?

( ) (X)Will a placebo be used in this study?

( ) (X)Will a subject control group be used?

If yes, (describe source, number, sex, age and special characteristics, if any)

Signatures:

Investigator Assurance:	*Department Chair Approval:*
I agree to accept responsibility for the scientific conduct of the protocol and to comply with Federal, State, and SHRP policies relative to the protection of the rights and welfare of human subjects. I will submit to the CRIR for review any changes in the protocol prior to its implementation. I also agree to provide the required annual/progress report and final report at the end of the study if this application is approved.	*I have reviewed this protocol and approve its submission to the CRIR*
Principal Investigator (per signature not acceptable)	*Department Chair (per signature not acceptable)*

Appendix A

IRB Application

Co-Investigator (per signature not acceptable) *Department Chair (per signature not acceptable)*

Co-Investigator (per signature not acceptable) *Department Chair (per signature not acceptable)*

Co-Investigator (per signature not acceptable) *Department Chair (per signature not acceptable)*

(If additional signatures are required, use an additional page)

NOTE: If you stated that CRIR approval was pending on your Federal Grant Application, you have 60 days from the submission deadline to provide the granting agency with an approval notice.

STUDY PROTOCOL

11. Background and Purpose of Proposed Study: (State briefly the reason for doing the study. What question(s) is it designed to answer and why is the question being asked? Include full references. Please limit to three key literature citations, if appropriate).

Both students' and instructors' cognitive learning styles are believed to influence the efficacy of learning. Although studies have primarily supported the need for student and instructor similarity in learning styles and educational strategies, they have been performed primarily at an undergraduate level. Some literature has addressed the use of cognitive learning styles in continuing education using a narrative approach.

In professional education for entry-level physical therapy students and practicing clinicians, there is a lack of documented evidence as to the best avenues for learning. Professional education must provide the entry-level physical therapy students educational opportunities to master the theoretical foundation for practice and the cutting-edge therapeutic approaches. In theory, the most effective teaching methods and instructional activities, as related to students' preferences and learning styles, should maximize learning outcomes. Research to validate these relationships is essential.

Purpose of the Study:The purpose of this study is to investigate the learning styles of physical therapy students and to assess if these styles relate to known demographics, such as age, gender, and the number of years of college education. The study will also determine if there are significant relationships between learning style and preferred teaching methods and instructional activities

Problem Statement: Based on the need to determine the preferred teaching methods and instructional activities which lead to mastery of material in physical therapy education and positive student attitudes towards the experience, the following questions are posed.

1. What are the learning style preferences of physical therapy students?

2. Do these styles correspond to known demographics, such as age, gender, or the number of years of college education?

3. Are there a logical relationship between learning style and preferred teaching methods, instructional activities, study time, and study setting?

The hypothesis is that relationships exist and students grouped by learning styles differ in their preference for both teaching methods and instructional activities. This information will provide the foundation for instructional and curriculum design that will produce the desired educational outcomes. In addition, the information will assist in student advisement in order to meet their responsibilities in the learning environment.

Appendix A

IRB Application

Literature Citations:

Bokoros, M.A., M.B. Goldstein, M.M. Sweeney (1992). Common factors in five measures of cognitive style. *Current Psychology: Research and Reviews*, 11, 99-109

Gregorc, A.F. (1982c). *Gregorc style delineator: Development, technical and administration manual*. Maynard, MA: Gabriel Systems, Inc.

O'Brien, T.P. & N.C. Wilkinson (1992). Cognitive styles and performance on the National Council of State Boards of Nursing Licensure Examination. *College Student Journal*, 26, 156-166.

12. Outline of Proposed Study: *(State briefly but precisely what is to be done. If the study is to be conducted according to a detailed protocol of a pharmaceutical company or other outside agency, include a summary here and attach the full protocol as an appendix. If the study involves the use of a questionnaire or structured interview, attach the text of such instruments as an appendix. Note: CRIR review focuses on the scientific merit and adequacy of experimental design as well as on issues of safety and protection of confidentiality)*

Assembled as a group, students will complete the questionnaires (attached in appendices) including 1) demographic information which consists of gender, age, and number of years of post-secondary education, 2) preference scales including teaching methods and instructional activities, and 3) the Gregorc Style Delineator (GSD). The questionnaire will be implemented in the beginning of several physical therapy classes, as coordinated with the course instructors. Students will be informed that the activity is voluntary, and those who decide not to participate may leave the classroom for the next half-hour. The students will not be asked their name, and anonymity will be maintained. Upon completion, the questionnaires will be collected and the information will be coded and analyzed.

13. Subjects: *(State the kind(s), ages, sex, and approximate numbers of subjects to be studied. Indicate the criteria for the selection of the proposed kinds and numbers of subjects. If populations at special risk (checklist) are to be studied, provide the reason(s) for their inclusion. Specify population groups to be excluded (e.g. pregnant women). The exclusion of women and minorities in research students must be specifically justified. Indicate composition of control groups)*

The subjects will consist of voluntary physical therapy students enrolled in the joint program of the University of Medicine and Dentistry of New Jersey/Kean College and of the University of Medicine and Dentistry/Rutgers University (Camden campus). The projected age range of the graduate students is about 22-40 years old. There is a potential of about 200 participants, of which there will be women and minorities represented with the other parts of the typical student body. There is no control group.

14. Drugs: *(Provide specific information on proposed dosage levels and schedules, including placebo, if any. Include both the generic and commercial name of each drug and summarize available*

Appendix A

IRB Application

information on efficacy and side effects. If none are to be administered, enter this statement: "No drugs will be given").

Not applicable; no drugs will be given

*15. **Blood Sampling:** (State the volume to be drawn on each occasion and the frequency of sampling from the same subject. If none is to be drawn, enter this statement: "No blood will be drawn").*

Not applicable; no blood will be drawn

*16. **Safety:** (State in adequate detail any anticipated physical, mental, or emotional risk to the subjects of this research activity and the degree of likelihood that it may occur. If no such risk is anticipated, state why this is so).*

There is no risk involved as the students will complete a questionnaire anonymously, and the questionnaire items consists of topics routinely used in the educational setting.

*17. **Confidentiality:** (Describe in adequate detail what measures will be taken to protect the confidentiality of the data to be obtained and the subject's rights to privacy).*

Confidentiality will be assured since the students will not put their names on the questionnaires, and there is no way to identify who completed the questionnaire once it is collected. Students will be informed of this prior to completing the questionnaire.

*18. **Informed Consent:** Complete an appropriate consent form (in 6th grade language) utilizing the checklist in the attached Part B.*

Where will the records containing the signed consent form be located(building and room #?

Informed consent form is not necessary as the students will volunteer to participate in completing the questionnaires and they will complete the questionnaires anonymously. Students who decide not to participate will leave the room for this session without ramifications of the course grade.

Who will obtain informed consent? Please list individual(s)/role(s) in project.

Name(s)	***Role(s) on the Project***

Appendix A

IRB Application

PART A

-

-

APPLICATION TO UNDERTAKE RESEARCH INVOLVING HUMAN SUBJECTS

-

General Instructions

Federal and Institutional regulations require that all research involving human subjects including those from whom organs, tissues, fluids, or other materials would be derived, or who could be identified by personal data, is submitted, prior to its initiation, for review and approval by the Comittee on Research and Institutional Review (CRIR) serving UMDNJ-School of Health Related Professions). Research and Sponsored Programs for each separate research project in accordance with the directions that follow:

A. Exempt Activities: Federal regulations provide that certain kinds of research activities involving human subjects are exempt from the requirement of full CRIR review. These are listed in Appendix A, p.9 An investigator requesting such exemption must submit an original and three copies of a completely filled out application. The specific paragraph(s) of the Federal guidelines (Appendix A) must be cited on the checklist. The material will be reviewed promptly by the CRIR. If exemption can be granted, the investigator will receive formal notification of approval. If exemption cannot be granted, the investigator will be notified and requested to submit under another category.

B. Expedited Review: Federal regulations provide that certain other kinds of research activities involving human subjects can be submitted for expedited review. These are listed in Appendix B, p.11

An investigator requesting expedited review must submit an original and three copies of a completely filled out application. The specific paragraph(s) of the Federal guidelines (Appendix B) must be cited on the checklist. This material will be reviewed by at least one member of the CRIR and revisions may be requested. The investigator will receive formal notification of approval. If review by the full CRIR is required the investigator will be requested to submit an additional14 copies.

Appendix A

IRB Application

C. All Other Protocols/Full CRIR Review: All research not covered by exempt or expedited procedures, requires submission of 15 copies of a completely filled out application with the study protocol and a consent form for full CRIR review. All of the elements of consent must be included in the written consent form for each study. A checklist for the consent form is attached. Deadlines for submission to the Chairperson of the Committee on Research and Institutional Review are listed on the attached cover memo.

Required Signatures: At least one original of each submitted protocol must be personally signed by each investigator(s) and countersigned by the chairman of each investigator's academic department.

All research involving human subjects is carried out and reviewed under the Multiple Projects Assurance approved by the U.S. Public Health Service, Department of Health and Human Services. Copies of this document are available in the Office of Research and Sponsored Programs, upon request.

APPENDIX A:

CODE OF FEDERAL REGULATIONS

TITLE 45: PUBLIC WELFARE

PART 46: PROTECTION OF HUMAN SUBJECTS

EXEMPT ACTIVITIES

Paragraph 46.101

(b) Unless otherwise required by Department or Agency heads, research activities in which the only involvement of human subjects will be in one or more of the following categories are exempt from this policy:

(1) Research conducted in established or commonly accepted educational settings, involving normal education practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods, unless (a) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (b) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey

Appendix A

IRB Application

procedures, interview procedures or observation of public behavior, unless: (please see a and b above)

(3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if:

(i) the human subjects are elected or appointed public officials or candidates for public office, or (ii) Federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

(5) Research and demonstration projects which are conducted by or subject to the approval of the Department or Agency heads, and which are designed to study, evaluate, or otherwise examine:

(i) Public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

(6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

APPENDIX B

CODE OF FEDERAL REGULATIONS

TITLE 45: PUBLIC WELFARE

PART 46: PROTECTION OF HUMAN SUBJECTS

EXPEDITED ACTIVITIES

Paragraph 46.110 (list of categories)

Research activities involving no more than minimal risk *and* in which the only involvement of humans subjects will be in one or more of the following categories (carried out through standard methods) may be reviewed by the Institutional Review Board through the expedited review procedure authorized in 46.110 of 45 CFR Part 46.

(1) Collection of: hair and nail clippings, in a nondisfiguring manner; deciduous teeth; and permanent teeth if patient care indicates a need for extraction.

(2) Collection of excreta and external secretions including sweat, uncannulated saliva, placenta removed at delivery, and amniotic fluid at the time of rupture of the membrane prior to or during

Appendix A

IRB Application

labor.

(3) Recording of data from subjects 18 years of age or older using noninvasive procedures routinely employed in clinical practice. This includes the use of physical sensors that are applied either to the surface of the body or at a distance and do not involve input of matter or significant amounts of energy into the subject or an invasion of the subject's privacy. It also includes such procedures as weighing, measuring height, testing sensory acuity, electrocardiography, electroencephalography, thermography,

detection of naturally occurring radioactivity, diagnostic echography, and electroretinography.

It does not include exposure to electromagnetic radiation outside the visible range (for example, x-rays, microwaves).

(4) Collection of blood samples by venipuncture, in amounts not exceeding 450 milliliters in an eight-week period and no more often than two times per week, from subjects 18 years of age or older and who are in good health and not pregnant.

(5) Collection of both supra- and subgingival dental plaque and calculus provided the procedure is not more invasive than routine prophylactic scaling of the teeth and the process is accomplished in accordance with accepted prophylactic techniques.

(6) Voice recordings made for research purposes such as investigations of speech defects.

(7) Moderate exercise by healthy volunteers.

(8) The study of existing data, documents, records, pathological specimens, or diagnostic specimens.

(9) Research on individual or group behavior or characteristics of individuals, such as studies of perception, cognition, game theory, or test development, where the investigator does not manipulate subjects' behavior and the research will not involve stress to subjects.

(10) Research on drugs or devices for which an investigational new drug exemption or an investigational device exemption is not required.

Appendix B

IRB Approval

UMDNJ-SCHOOL OF HEALTH RELATED PROFESSIONS
COMMITTEE ON RESEARCH AND INSTITUTIONAL REVIEW (CRIR)

NOTICE OF APPROVAL

CRIR PROPOSAL NUMBER 190
(Refer to this number when making inquiries)

PRINCIPAL INVESTIGATOR: Valerie G. Olson, M.S., P.T.

CO-INVESTIGATOR(S): Craig L. Scanlan, Ed. D.

PROTOCOL TITLE: Relationship of Learning Styles to Preferences for Teaching Methods and Instructional Activities

PROPOSED DATES OF STUDY:

NATURE OF REVIEW:

FULL____ EXPEDITED____ EXEMPT_X

TYPE OF APPROVAL:

APPROVED _X___ CONDITIONAL APPROVAL____ NOT APPROVED
COMMITTEE MEETING DATE: N/A

Please note the following requirements:

ADVERSE REACTIONS: If any serious, unexpected adverse reactions occur as a result of this study, you must notify the IRB Administrator immediately.

CONSENT FORM: All Research Subjects should receive a signed copy of the consent form. (This requirement is waived)

RENEWAL: You are required to apply for renewal of approval at least annually for as long as the study is active.

Date: 4 October 1999

Carlos Wilson Pratt, Ph.D.
Chairperson
Committee on Research and Institutional Review

Appendix C

Cover Letter and Survey Tool

GRADUATE PROGRAMS
in the HEALTH SCIENCES
Seton Hall University • McQuaid Hall
South Orange • New Jersey 07079-2685

(973) 761-7145

September, 1999

Dear Student,

Thank you for participating in this research project, which is a partial requirement for my dissertation. As a doctoral candidate, I am investigating students' preferences of teaching methods and instructional activities. There is some research in the health-care disciplines, but a few limited studies exploring the preferences of physical therapy students. Participation in this project is voluntary and you will not be putting your name on the questionnaire.

I will be collecting the data from the questionnaires, then analyze and pool the data so that students who completed the questionnaire cannot be identified. The analysis will be performed on the groups of anonymous data and not individually.

If you would like the outcomes of this study, please leave me your name and address, and I will send you the results upon completion of this project at the end of the year.

Your efforts are greatly appreciated and contribute to the field of physical therapy education.

Sincerely,
Valerie Olson, MS, PT
Valerie Olson, MS, PT

OFFERED IN COLLABORATION
SETON HALL UNIVERSITY - School of Graduate Medical Education
UNIVERSITY OF MEDICINE & DENTISTRY OF NEW JERSEY - School of Health Related Professions

Appendix C

Cover Letter and Survey Tool

INVESTIGATION OF STUDENT LEARNING STYLES

I. BIOGRAPHIC INVENTORY

INDICATE YOUR SEX:
Female ____ Male ____

INDICATE YOUR AGE IN YEARS AT YOUR LAST BIRTHDAY: ____

WHICH ONE OF THE FOLLOWING DESCRIBES YOUR RACE OR ETHNIC ORIGIN?
____ American Indian or Alaskan Native
____ African American/Black (not of Hispanic Origin)
____ White (not of Hispanic Origin)
____ Asian or Pacific Islander
____ Hispanic/Latino
____ Other

WHAT YEAR ARE YOU IN YOUR PROFESSIONAL PROGRAM?
Year 1 ____ Year 2 ____ Year 3 ____

HOW MANY YEARS OF COLLEGE SINCE HIGH SCHOOL? : ____

Of the number of years after high school, how many are full time? : ____
How many are part time: ____

II. GREGORC STYLE DELINEATOR

READ THE DIRECTIONS WITH THE PROCTOR AND THEN COMPLETE THE GSD TOOL, ON THE FOLLOWING TWO PAGES.

Appendix C

Cover Letter and Survey Tool

GREGORC STYLE DELINEATOR™ RESEARCH INSTRUMENT

DIRECTIONS

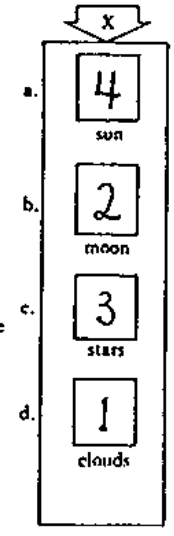
Before starting with the word matrix on the next page, carefully read all seven of the following directions and suggestions:

1. **Reference Point.** You must assess the relative value of the words in each group using your SELF as a reference point; that is, who you are deep down, NOT who you are at home, at work, at school or who you would like to be or feel you ought to be. THE REAL YOU MUST BE THE REFERENCE POINT.
2. **Words.** The words used in the *Gregorc Style Delineator* matrix are not parallel in construction nor are they all adjectives or all nouns. This was done on purpose. Just react to the words as they are presented.
3. **Rank.** Rank in order the ten sets of four words. Put a "4" in the box above the word in each set which is the best and most powerful descriptor of your SELF. Give a "3" to the word which is the next most like you, a "2" to the next and a "1" to the word which is the least descriptive of your SELF. Each word in a set must have a ranking of 4, 3, 2 or 1. No two words in a set can have the same rank.

4 = MOST descriptive of you
1 = LEAST descriptive of you

4. **React.** To rank the words in a set, react to your *first impression*. There are no "right" or "wrong" answers. The real, deep-down you is best revealed through a first impression. Go with it. Analyzing each group will obscure the qualities of SELF sought by the Delineator.
5. **Proceed.** Continue to rank all ten vertical columns of words, one set at a time.
6. **Time.** Recommended time for word ranking: 3 minutes.
7. **Start.** Turn the page and start now.

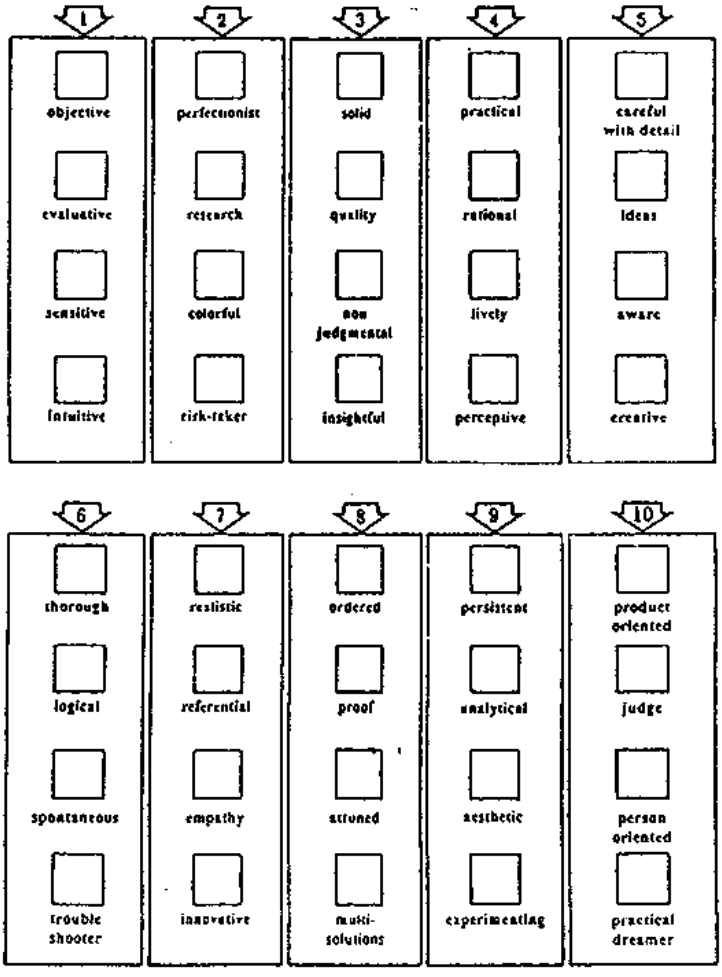
Example



Appendix C

Cover Letter and Survey Tool

WORD MATRIX



PUBLISHED BY
GREGORC ASSOCIATES, INC.
P.O. BOX 351
COLUMBIA, CT 06237

Adapted on 9/13/99

Appendix C

Cover Letter and Survey Tool

III. TEACHING METHODS

INSTRUCTIONS: **Listed below are different teaching methods an instructor can use. Circle the number the best represents your preferences in teaching methods.**

Item	Not Preferred		Neutral		Highly Preferred
Uses trial and error discovery	1	2	3	4	5
Uses programmed instruction	1	2	3	4	5
Fosters creative products	1	2	3	4	5
Guides individual study	1	2	3	4	5
Enforces orderly classroom and lab	1	2	3	4	5
Assigns optional reading	1	2	3	4	5
Insists students think for themselves	1	2	3	4	5
Provides manuals and projects	1	2	3	4	5
Enhances the mood of the class	1	2	3	4	5
Teaches from a base of content expertise	1	2	3	4	5
Personalizes the class	1	2	3	4	5
Provides long-range planning	1	2	3	4	5
Promotes a positive mood	1	2	3	4	5
Employs computer-aided information	1	2	3	4	5

IV. STUDY SETTINGS

INSTRUCTIONS: **Listed below are different study settings students can use in outside of class. Circle the number the best represents your preferences in study times.**

Item	Not Preferred		Neutral		Highly Preferred
Informal	1	2	3	4	5
Quiet	1	2	3	4	5
Solo study	1	2	3	4	5
Bright light	1	2	3	4	5
Group	1	2	3	4	5
No eating	1	2	3	4	5
Soft music	1	2	3	4	5
Movement	1	2	3	4	5
Eating	1	2	3	4	5
Formal setting	1	2	3	4	5
No movement	1	2	3	4	5
Dim light	1	2	3	4	5
Loud music	1	2	3	4	5

Appendix C

Cover Letter and Survey Tool

V. STUDY TIME

INSTRUCTIONS: **Listed below are different study times students can use outside of class. Circle the number the best represents your preferences in study times.**

Item	Not Preferred		Neutral		Highly Preferred
Early morning	1	2	3	4	5
Mid-morning	1	2	3	4	5
Late morning	1	2	3	4	5
Early afternoon	1	2	3	4	5
Late afternoon	1	2	3	4	5
Early evening	1	2	3	4	5
Evening	1	2	3	4	5
Late evening	1	2	3	4	5

VI. INSTRUCTIONAL ACTIVITIES

INSTRUCTIONS: **Listed below are different instructional activities students can use in a class. Circle the number the best represents your preferences in instructional activities.**

Item	Not Preferred		Neutral		Highly Preferred
Experiments	1	2	3	4	5
Lecture	1	2	3	4	5
Personal Content	1	2	3	4	5
Textbooks	1	2	3	4	5
Group discussion	1	2	3	4	5
Workbooks	1	2	3	4	5
Handouts	1	2	3	4	5
Simulations	1	2	3	4	5
Mini-lectures	1	2	3	4	5
Audiotapes	1	2	3	4	5
Use of media	1	2	3	4	5
Drills	1	2	3	4	5
Demonstrations	1	2	3	4	5
Practical application	1	2	3	4	5
Critical issues	1	2	3	4	5
Documented evidence	1	2	3	4	5
Individual work	1	2	3	4	5
Theme instead of detail	1	2	3	4	5
Hands-on practice	1	2	3	4	5
Interactive video	1	2	3	4	5

THANK YOU FOR YOUR ASSISTANCE!

Questionnaire final

Appendix D

Factor Loadings for All TM Scales

Component Matrix

	Component			
	1	2	3	4
TRIAL/ERROR	-5.037E-02	.473	-.409	6.165E-02
PROG INSTRUCTION	9.682E-02	-.127	.330	.726
CREATIVE PROD	.321	.507	-.311	.303
INDIVIDUAL STUDY	.297	.662	-7.327E-02	.273
ORDERLY CLASSRM/LAB	.289	8.206E-03	.647	.236
OPTIONAL READING	.130	.266	.425	-.499
THINK FOR SELF	.246	.678	6.061E-02	-.146
MANUALS/PROJECTS	.479	.178	.241	-.251
MOOD OF CLASS	.746	-.245	-.137	2.666E-02
CONTENT EXPERTISE	.629	-8.875E-02	.261	-3.784E-02
PERSONALIZED CLASS	.537	-.299	-.470	-.175
LONG-RANGE PLANNING	.547	-1.428E-02	-1.768E-02	-5.590E-02
POSITIVE MOOD	.728	-.316	-.184	7.913E-02
COMPUTER-AIDED INFO	.159	.153	.193	-.135

Extraction Method: Principal Component Analysis.
a 4 components extracted.

Appendix E

Rotated 4 Factor Solution for TM Scales

Rotated Component Matrix

	Component			
	1	2	3	4
TRIAL/ERROR	-9.892E-02	.548	-.101	-.277
PROG INSTRUCTION	5.086E-03	5.412E-02	-.271	.765
CREATIVE PROD	.177	.716	-5.188E-02	3.948E-02
INDIVIDUAL STUDY	2.875E-02	.744	.160	.159
ORDERLY CLASSRM/LAB	4.895E-02	-7.017E-02	.335	.662
OPTIONAL READING	-9.016E-02	-7.228E-02	.708	-6.176E-02
THINK FOR SELF	-4.497E-02	.551	.485	-6.129E-02
MANUALS/PROJECTS	.295	9.199E-02	.531	7.692E-02
MOOD OF CLASS	.786	3.603E-02	5.742E-02	.114
CONTENT EXPERTISE	.510	-2.681E-02	.354	.295
PERSONALIZED CLASS	.729	-1.241E-02	-.106	-.293
LONG-RANGE PLANNING	.494	.108	.204	7.245E-02
POSITIVE MOOD	.809	7.339E-03	-3.715E-02	.121
COMPUTER-AIDED INFO	3.138E-02	5.014E-02	.312	5.704E-02

Extraction Method: Principal Component Analysis. Rotation Method: Equamax with Kaiser Normalization.
a Rotation converged in 5 iterations.

Appendix F

Factor Loadings for All IA Scales

Component Matrix

	Component			
	1	2	3	4
EXPERIMENTS	.351	-.235	-6.124E-02	3.913E-02
LECTURE	2.380E-02	.664	.277	.119
PERSONAL CONTENT	.271	3.365E-02	.144	.646
TEXTBOOKS	.122	.518	-4.835E-02	.294
GROUP DISCUSSION	.506	-.397	-.161	.426
WORKBOOKS	.545	3.267E-03	-.118	.500
HANDOUTS	.288	.443	.193	-.102
SIMULATIONS	.609	-7.609E-02	.228	-.172
MINI-LECTURES	.381	.106	5.755E-02	-.361
AUDIOTAPES	.464	.265	-.495	-7.106E-02
USE OF MEDIA	.500	.197	-.317	-.421
DRILLS	.571	-8.528E-02	-.236	-8.612E-02
DEMONSTRA-TIONS	.511	-.104	.219	-.258
PRACTICAL APPLICATION	.565	-.222	.389	-8.413E-03
CRITICAL ISSUES	.456	.118	.418	-1.351E-02
DOCUMENTED EVIDENCE	.256	.426	.149	3.143E-02
INDIVIDUAL WORK	.397	.211	5.676E-03	8.502E-02
THEME	.481	-2.103E-02	-.112	-6.593E-03
HANDS-ON PRACTICE	.492	-.346	.406	-8.673E-02
INTERACTIVE VIDEO	.556	2.019E-02	-.496	-7.105E-03

Extraction Method: Principal Component Analysis.
a 4 components extracted.

Appendix G

Rotated 4 Factor Solution for IA Scales

Rotated Component Matrix

	Component			
	1	2	3	4
EXPERIMENTS	.239	.209	.244	-.152
LECTURE	-5.192E-02	-.126	-4.945E-02	.715
PERSONAL CONTENT	3.629E-02	-.155	.661	.224
TEXTBOOKS	-.212	8.080E-02	.204	.528
GROUP DISCUSSION	.193	.217	.691	-.244
WORKBOOKS	9.754E-02	.241	.684	.156
HANDOUTS	.200	.138	-6.968E-02	.513
SIMULATIONS	.605	.258	.118	.107
MINI-LECTURES	.360	.330	-.171	.146
AUDIOTAPES	-8.559E-02	.691	.131	.183
USE OF MEDIA	.188	.699	-.158	.133
DRILLS	.259	.529	.217	-3.846E-02
DEMONSTRA-TIONS	.575	.231	6.834E-03	4.560E-02
PRACTICAL APPLICATION	.671	4.180E-02	.257	3.639E-02
CRITICAL ISSUES	.519	4.849E-03	.131	.332
DOCUMENTED EVIDENCE	.113	.101	3.871E-02	.496
INDIVIDUAL WORK	.157	.238	.205	.293
THEME	.236	.370	.222	4.980E-02
HANDS-ON PRACTICE	.701	-5.192E-03	.182	-9.913E-02
INTERACTIVE VIDEO	2.535E-02	.691	.278	-1.301E-02

Extraction Method: Principal Component Analysis. Rotation Method: Equamax with Kaiser Normalization.

a Rotation converged in 7 iterations.