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THE EFFECTS OF COGNITIVE STYLE
ON THE LEARNING PREFERENCES
OF GRADUATE SCHOOL STUDENTS

THESIS

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THE EFFECTS OF COGNITIVE STYLE ON THE LEARNING PREFERENCES
OF GRADUATE SCHOOL STUDENTS

THESIS

Presented to the Faculty of the School of Systems and
Logistics of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Logistics Management

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September 1993

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John W. Underwood

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Abstract

This research establishes significant relationships between an individual's cognitive style, measured by the Myers-Briggs Type Indicator (MBTI), and the learning preferences of that individual, measured by the Learning Style Survey. The sample consisted of 529 Air Force Institute of Technology (AFIT) graduate students in the School of Systems and Logistics from 1988 to 1992, who completed four tests, a pre-test MBTI and LSS and a post-test MBTI and LSS.

This research utilized Chi-Squared Goodness of Fit procedures, determining that some learning methods, techniques, and devices (MTDs) are most preferred or least preferred by all four cognitive style types, Sensing-Thinking (ST), Sensing-Feeling (SF), Intuitive-Thinking (NT), and Intuitive-Feeling (NF).

"Group Discussion" was significantly most preferred by all types in both the pre-test and the post-test, while "Memorization" and "Pop Quizzes" were least preferred by all types. Significant differences among the types were noted for both most preferred and least preferred MTDs and significant changes are noted in both cognitive types and learning preferences between pre and post tests.

Recommendations for additional research are provided.

THE EFFECTS OF COGNITIVE STYLE ON THE LEARNING PREFERENCES OF GRADUATE SCHOOL STUDENTS

I. Introduction

Background

The concept of learning style recognizes that people differ in how they perceive and process information (cognitive style), interact socially within the educational environment, and react to various learning and instructional methods. This concept is not new. Plato, the Greek philosopher, was one of the first to understand these differences and often assigned his pupils tasks based upon their individual abilities (Anastasi, 1958:2-3). According to one expert, individual learning differences have been acknowledged by psychologists for many years (Gagne, 1967:xi); however, only recently, beginning in the 1960s, has the concept of individual differences received the widespread attention of learning theorists and educators. Presently, there are at least fourteen popular theories and models of learning style (Claxton and Murrell, 1987:8-53).

In a critical step toward applying theory to practice, learning theorists and researchers have developed learning style measurement instruments. These instruments are normally self-report surveys which require the respondent to make choices regarding aspects of his or her learning style, and the results are used to classify individuals along

scales or into matrix cells which represent learning style dimensions or types (Sewall, 1986:4-8). The measurement instruments most commonly used focus only on one or two components of learning style, such as cognitive style factors, social interaction, or learning preferences (Claxton and Murrell, 1987:8-53). This narrow focus is necessary because it would be virtually impossible to fully measure all aspects of individual learning style with only one survey.

According to Claxton and Murrell, the proper application of the concept of learning style can greatly improve teaching and learning processes in higher education (1987:77). Teachers who have information regarding the learning styles of their students are more aware of the individual differences which exist in their classrooms. This information can also enable them to better design learning strategies to accomplish their teaching objectives. From the perspective of the student, some research findings suggest that students who are briefed on their learning style prior to the beginning of instruction perform better than those who are not (Claxton and Murrell, 1987:77-78).

Specific Problem Area

At the Air Force Institute of Technology (AFIT), graduate school students have been administered two types of surveys to determine learning style preferences. One of these surveys is the Myers-Briggs Type Indicator (MBTI)

which measures individual cognitive style (Gibson and others, 1991:82). The other instrument, called the Learning Style Survey (LSS), is designed to measure individual preferences for learning "methods, techniques, and devices (MTDs)" (Campbell, 1992). Each student completed a pre-test and post-test of both surveys. The pre-tests were administered during the students' orientation period, prior to the start of any classes. The students completed the post-tests shortly before their graduation, approximately fifteen months later.

As of yet, the learning style data collected by these two measurement instruments has not been statistically analyzed and interpreted. Because the surveys measure two different components of learning style, the data provide an opportunity to determine if there are any relationships between them. Also, due to the pre-tests and post-tests, there is longitudinal data, making it possible to measure for changes in either or both of the learning style components and in their relationships to each other.

The results of this research can add to the knowledge of how student cognitive style and learning preferences are related. This knowledge can increase the graduate school instructors' awareness and sensitivity to the learning MTDs preferred by the different cognitive style types within their classrooms. Therefore, it can provide faculty with more tools to design learning experiences which specifically address the objectives they have for their students. And,

by measuring for changes in the two learning style components, this research can provide insights concerning how student learning styles are modified as a result of the educational process.

Research Question

This research seeks to answer the following question: What are the relationships between the cognitive style types of AFIT students and their preferences for learning MTDs, as measured by the pre-test and post-test MBTI and LSS?

The null and research hypotheses for this question are:

Ho: There are no significant relationships between the cognitive style type of AFIT students and their preferences for learning MTDs, as measured by the pre-test and post-test MBTI and LSS.

Ha: The cognitive style types of AFIT students are significantly related to their preferences for learning MTDs, as measured by the pre-test and post-test MBTI and LSS.

Investigative Questions

In determining whether or not significant relationships exist between student cognitive style and preferences for MTDs, six investigative questions must be resolved. Two of these questions are considered pivotal because their answers are essential to answering the research question. These pivotal questions are marked with an "*".

1. *What is the reliability and validity of the MBTI and LSS?* Unless both instruments demonstrate sufficient reliability and validity, it is impossible to draw research conclusions based on the data collected by them.

Ho: The MBTI and LSS do not demonstrate reliability and validity.

Ha: The MBTI and LSS demonstrate reliability and validity.

2. *Is the distribution of cognitive style types, as measured by the pre-test MBTI, different from that of the general population?* The answer to this question determines whether the research findings are applicable only to the AFIT environment or whether they may also be generalized to other graduate schools.

Ho: AFIT students have the same distribution of cognitive style types as the general population.

Ha: The distribution of cognitive style types of AFIT students is different than that of the general population.

*3. *As measured by the pre-test MBTI and LSS, what are the relationships of the cognitive style types to preferences for learning MTDs?* The objective of this question is to assess any relationships which exist prior to the students beginning the graduate school educational process.

Ho: The cognitive style types of AFIT students are not significantly related to their preferences for learning MTDs, as measured by the pre-test MBTI and LSS.

Ha: The cognitive style types of AFIT students are significantly related to their preferences for learning MTDs, as measured by the pre-test MBTI and LSS.

4. Do cognitive style types change during the time between the pre-test and post-test MBTI? This question tests the theory that an individual's cognitive style is fairly stable over time.

Ho: AFIT student cognitive style types do not change significantly during the time between the pre-test and post-test MBTI.

Ha: AFIT student cognitive style types do change significantly during the time between the pre-test and post-test MBTI.

5. Do preferences for learning MTDs change during the time between the pre-test and post-test LSS? The answer to this question determines how stable or dynamic AFIT student learning preferences are.

Ho: AFIT student preferences for learning MTDs do not change significantly during the time between the pre-test and post-test LSS.

Ha: AFIT student preferences for learning MTDs do change significantly during the time between the pre-test and post-test LSS.

***6. If there were significant relationships between cognitive style types and preferences for learning MTDs, as measured by the pre-test MBTI and LSS, have these relationships changed significantly, as compared to the**

post-test MBTI and LSS measurements? The objective of this question is to determine how stable or dynamic the relationships between cognitive style types and learning preferences are, over time.

Ho: The relationships between AFIT student cognitive style types and their preferences for learning MTDs do not change significantly during the time between the pre-test and post-test MBTI and LSS.

Ha: The relationships between AFIT student cognitive style types and their preferences for learning MTDs do change significantly during the time between the pre-test and post-test MBTI and LSS.

Scope of this Research

This study uses a large sample of AFIT students. All subjects completed a Masters of Science program at the AFIT School of Systems and Logistics and graduated during the past five years. The subjects are all military officers and Department of Defense civilian managers who are similar in terms of age, educational level, and job experience.

This research is bounded by the four limitations listed below.

1. This research is limited to analyzing two learning style components: cognitive style and preferences for learning methods, techniques, and devices. The MBTI provides measures of student cognitive style and the LSS assesses the students' preferences for learning methods,

techniques, and devices. The two other components of individual learning style, personality characteristics and social interactions, are not measured by either instrument and are not considered by this study.

2. The LSS had not been independently tested for reliability and validity prior to this research. It is tested for content validity and stability as part of this study, however, remains untested in terms of the other categories of reliability and validity.

3. Both the MBTI and LSS rely on respondents to self-report information concerning their learning styles. The self-reports are assumed to reflect the participants' honest responses and permit analysis.

4. The scope of this research cannot address all of the possible factors which may contribute to changes that occur in either or both of the learning style components from the time of the pre-tests to the post-tests.

Assumptions

Five assumptions are necessary to provide operational guidelines for this study.

1. This sample of AFIT students is representative of the general population. The second investigative question tests the validity of this assumption. Without it, the research findings may only apply to AFIT School of Systems and Logistics students.

2. The mean and variance measures of the sample are representative of the general population of graduate school students. This assumption is related to the first assumption and is necessary for the same reason.

3. The measurement instruments used provide consistent and accurate measures of the learning style components they attempt to identify. The first investigative question tests this assumption.

4. The definition of learning style used in this research is valid. There are many theories, models, and definitions of learning style. Claxton and Murrell conducted an extensive literature review and synthesized many ideas into one broad classification of learning style. According to this classification, individual learning style consists of the following four components: personality characteristics, cognitive style, social interactions, and learning and instructional preferences (1987: 77). This definition is fully detailed in Chapter II of this report.

5. Both measurement instruments used in this study require the respondents to answer questions regarding his or her learning style. It is assumed that the majority of the respondents answered the questions truthfully.

Key Terms

The following are key terms and acronyms which will be referred to throughout this report.

AFIT: Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio.

Cognitive Style: Describes an individual's preferences and tendencies for perceiving and processing information (Claxton and Murrell, 1987: 7). For this research, individual cognitive style is represented by the two-letter combination from the two MBTI polar scales of Sensing-Intuition (S-N) and Thinking-Feeling (T-F).

Learning Style: A broad concept which recognizes that people differ in terms of personality characteristics, cognitive style, social interactions, and learning preferences (Claxton and Murrell, 1987: 77).

Learning Style Survey (LSS): A measurement instrument which surveys individual preferences for thirty-four different learning methods, techniques, and devices.

MTDs: Methods, techniques, and devices.

Myers-Briggs Type Indicator (MBTI): A survey which measures individual psychological types.

Summary and Overview

This chapter provided general background information and described the specific problem area which is addressed by this research. This study's objectives, in the form of the research question and its subordinate investigative questions, were outlined. The scope of this research, its assumptions, and its limitations were presented. The

chapter concluded with a listing of key terms and acronyms which will be used throughout this report.

The next chapter provides a review of learning style theory, measurement tools, and relevant previous studies.

Chapter II. Literature Review

Introduction

This chapter provides a review of the literature relevant to this research. First, a model which serves to define learning style is presented. The review then focuses on the learning style component of cognitive style by examining Carl Jung's psychological theory and its application through the use of the Myers-Briggs Type Indicator (MBTI).

The next section addresses the other learning style component of interest to this study, instructional and learning preferences. The following section reviews previous studies which investigated relationships between MBTI psychological types and instructional and learning preferences.

Learning Style Model

The study of individual differences began as soon as man began putting thoughts and theories to paper (Anastasi, 1958:2-3). By the start of the 20th century, experimental psychology, mental tests, and statistical methods of analysis were commonly used and combined to give the study of individual differences a foundation for future research (Anastasi, 1958:8-18).

The study of individual differences is separated into two distinctly different schools of thought. The first

school describes individual behavior as enduring, consistent over time, and rooted in early childhood development. The other school, espousing social theories, emphasizes that behavior is influenced more by the current and recent environmental surroundings of the individual (Gibson and others, 1991:58-59). The school of thought may vary, but "the fundamental aim of differential psychology is the understanding of behavior and its ultimate unit is the individual" (Anastasi, 1958:628). The concept of individual learning style developed from the theories of individual differences.

Learning style, as an educational concept, has no "generally accepted" definition (Claxton and Murrell, 1987:5). In fact, there are many definitions, ranging from general to very specific (Sewall, 1986:3). The specific definitions are grounded in particular theories or models of learning style, while the general definitions attempt to incorporate much, if not all, that has been learned from these theories.

Curry, as reported by Claxton and Murrell, developed a broad model in 1983 which uses the metaphor of an onion to define learning style (1987:7). Figure 1 illustrates Curry's model.

According to this model, there are four components, or "layers," of each person's learning style. In the center, represented by the core of the onion, are the individual's basic personality characteristics. The next layer consists

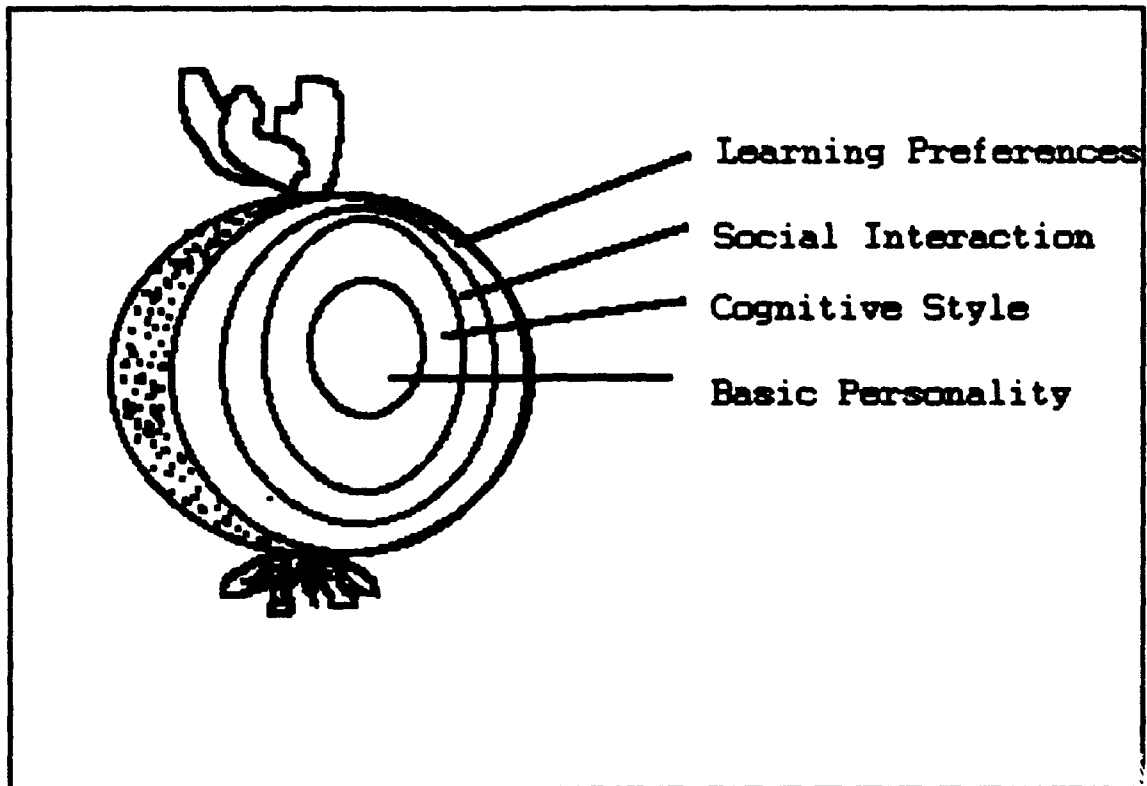


Figure 1. Curry's "Onion" Learning Style Model (Claxton and Murrell, 1987:7)

of cognitive factors which are individual preferences, or tendencies, for perceiving and processing information. The third layer addresses social interactions as an aspect of learning style, describing how the individual acts in the educational setting and interacts with others. Student preferences for learning and instructional methods comprise the final layer of the model. These four components together comprise individual learning style. (Claxton and Murrell, 1987:7-8).

Claxton and Murrell clarify Curry's model by describing how it functions. First, the factors and traits which form the inner layers influence those of each succeeding outer

layer. Furthermore, the basic personality characteristics found in the center are "the most stable and thus least subject to change," while those factors in the outer layers are more dynamic (1987:7).

For the purposes of this research, Curry's definition of learning style is accepted. This thesis is concerned with the second and fourth components of learning style. The remainder of this chapter reviews the literature which pertains to individual cognitive style and learning preferences, as well as the surveys used to provide measurements of these two components.

Cognitive Style

Jungian Theory. Carl Jung published his theory of psychological types in 1921 (Portable, 1971:xx). His theory is based on individual cognitive style factors which are represented by attitudes and functions. The attitudes are extraversion, in which an individual reacts externally, and introversion, where an individual reacts internally (Watson, 1989:30). Jung felt the different types "present such a striking contrast that their existence becomes quite obvious even to the layman once it has been pointed out" (Jung, 1971:179). Jung's functions follow his belief that every living organism gathers information and makes decisions, which are processed through two functions, perception and judgement (Myers and McCaulley, 1985:16-17). This belief leads to his next two polar areas, the perceptive functions

of sensors as opposed to intuitives and the judgement functions of thinkers as opposed to feelers (Kroeger, 1992:32). The display of the functions in the outer world is characterized by the individuals preference for judgement or perception (Myers and McCaulley, 1985:14). A more detailed examination of the interaction between attitudes and functions is discussed later in this review.

Jung saw the preferences as opposites, although he conceded most people will not be fully driven by any of the eight preferences, but instead will show degrees of propensity toward one or the other counter positions. Although Jung felt the individual preferences are genetic, the degree for the preference may strengthen or weaken over time, depending upon its use (Keirsey and Bates, 1978:13-14). This particular idea of Jung's, the strengthening and weakening of preferences, will be tested as part of this thesis for the cognitive style types of the individuals in the sample.

Jung devoted most of his writings to the description of the attitudes of extraversion and introversion, which are seen as opposite orientations toward life (Myers and McCaulley, 1985:13). Extraverts have a need for sociability, experiencing loneliness when they are not in contact with others, while introverts are territorial, preferring private places for solitary activities (Keirsey and Bates, 1978:14-15). Key words or phrases which describe an extravert include "breadth", "external", "interaction",

"multiplicity of relationships", and "expenditure of energy", as opposed to introvert descriptions of "depth", "internal", "concentration", "limited relationships", and "conservation of energy" (Keirsey and Bates, 1978:16).

Jung divided the perceptive activities, which he calls the "irrational function," into sensing and intuition, because they center on the flow of events and are not constrained by rational direction. Sensing describes perception which is observable largely by the five senses of sight, sound, touch, smell, and taste, while the intuitive type perceives possibilities, meanings, and relationships by way of insight. The strong sensing type is acutely aware of his or her immediate surroundings, while the intuitive type relies on what could be called a "hunch" (Myers and McCaulley, 1985:12). Words and phrases associated with sensors include "experience", "wisdom of the past", and "realistic outlooks", while the intuitive type values "premonition", "vision of the future", and "speculation". Sensing types tend to react more positively to terms like "down-to-earth", "no-nonsense", and "practical", as opposed to the intuitive interests of "fascination", "fantasy", and "imagination" (Keirsey and Bates, 1978:19).

Jung's other function, judgement, considers more rational processes because it incorporates reasoning into decision making. The two opposite dimensions of this function are thinking and feeling. Thinking types attempt to use a logical approach and often arrive at an impersonal

finding, while the feeling type is much more likely to base his or her decisions on subjective, personal values (Lawrence, 1982:8). Likely portraits of thinkers include "objectivity", "principled", "policy-driven", and "firm". Feelers are classified with terms like "subjectivity", "values", "extenuating circumstances", and "persuasion" (Keirsey and Bates, 1978:22).

Jung never explicitly described the polar areas of judgement and perception; however, Isabel Briggs Myers and her mother, Katharine Briggs, felt orientations were implicit in Jung's work and included them in the development of their personality type indicator, the Meyers-Briggs Type Indicator (MBTI). The two women studied Jung's theory and developed the judgement-perception preference for use in the MBTI for two reasons: to describe identifiable behaviors to the outside world and to identify, in conjunction with the extravert-introvert attitudes, which of the two preferred functions is the leading or dominant function and which is the auxiliary. Based on their research, they added the fourth scale to Jung's theory (Myers and McCaulley, 1985:13).

Although the words are sometimes seen as "judgmental" and "perceptive", the theory behind the two is not consistent with that observation. Those with a preference for judgement are found to be no more judgmental than those with a preference for perception, just as those preferring perception are no more perceptive than a judgement type

(Keirsey and Bates, 1978:23). The two preferences are considered in the same way that Jung specifically addressed extraverts and introverts as attitudes (Myers and McCaulley, 1985:293). Expressions a judgment type may find acceptable are "settled", "fixed", "plan ahead", "decisive", and "deadlines", while the perceptive type is more agreeable to terminology such as "pending", "flexible", "adapt as you go", "tentative", and "wait-and-see" (Keirsey and Bates, 1978:24).

MBTI's Application of Jungian Theory. The MBTI is a questionnaire developed by Myers and Briggs as a measurement instrument for Jung's theory of psychological types (McCaulley, 1989:4). It is a forced-choice, self-report survey which yields four scales. These scales, when combined, produce one of sixteen possible personality types. (Sewall, 1986:7,12) Figure 2 illustrates how the four scales produce the sixteen possible types.

Following Jung's theory that one pole in each of the four preferences is favored over the other pole, the MBTI asks questions of everyday events to stimulate a preferred response. Each question pertains to one of the four dichotomous preferences; extraversion (E) or introversion (I), sensing (S) or intuition (N), thinking (T) or feeling (F), and judgement (J) or perception (P) (Myers and McCaulley, 1985:2-3).

Myers and McCaulley emphasize that the MBTI is not a test with hard answers. Instead, it gives an indication of

an individual's preferences. Responses to each question are weighted and an overall score is given to indicate a respondent's preference for one aspect over the other, when forced to choose. Raw scores are given to each of the eight test regions, then the differences between the polar areas are compared to determine a "preference score." Scores of 21 or more indicate a clear preference. Scores of 10 or more, but less than 21, indicate moderate preferences. And scores with single digits indicate a slight preference (1985:2,9,58). The main objective of the MBTI is to determine the stronger preferences of the individual, which are combined to form one of the 16 personality types.

Dominant Functions. Myers and Briggs developed the MBTI with emphasis on Jung's theory of a dominant function within the individual (Myers and McCaulley, 1985:15). The MBTI psychological types incorporate the dynamics of Jung's dominant functions. Jung first portrayed the theory of dominant functions in his 1921 work *Psychological Types*, where he wrote that one function will have "absolute sovereignty" over other functions (Jung, 1971:266). To incorporate Jung's theory, Myers and Briggs employs the final letter of the four-letter MBTI psychological type, J or P, as the first step towards determining the dominant function. The preference will point to the individual's extraverted function, irrespective of the person's preference for extraversion or introversion (Myers and McCaulley, 1985:14).

	SENSING		INTUITION	
	With Thinking	With Feeling	With Feeling	With Thinking
INTROVERSION				
With Judging	ISTJ	ISFJ	INFJ	INTJ
With Perceiving	ISTP	ISFP	INFP	INTP
EXTRAVERSION				
With Perceiving	ESTP	ESFP	ENFP	ENTP
With Judging	ESTJ	ESFJ	ENFJ	ENTJ

Figure 2. The Myers-Briggs Type Indicator Matrix (Kroeger, 1992:44)

If the individual is an extravert (E), the J-P index will directly identify the dominant function. If the individual is an introvert, the J-P scale will still point to the extraverted function, but the dominant function will be the other function of the four-letter scale. For example, the thinking function is dominant for an ESTJ, since the individual is an extravert, preferring judgement over perception; therefore, the J points directly to T as the dominant function. Using ISTJ as an illustration for an introvert, the J points to thinking (T) as the extraverted function, just as it did for the ESTJ. However, because this individual shows a preference for introversion, the

introverted function, in this case the S, is the dominant function. Both individuals will use the thinking (T) function in the outer world (extraversion), as others would see them, and sensing (S) would be the function used in the inner world (introversion). The dominance of one or the other differs only because of the first scale of the MBTI, with individuals using their dominant function for their preferred attitude (E or I). In theory, the ESTJ is dominated by a logical, reasoned approach to life, while the ISTJ is extremely familiar with their surroundings and the use of their five senses (Myers and McCaulley, 1985:16-17). Table 1 shows the dominant function for each of the sixteen types.

MBTI Cognitive Style Types. The MBTI measurements of primary relevance to this thesis are the pairings of the sensing-intuitive (S-N) and thinking-feeling (T-F) scale scores, which represent individual cognitive style types. According to Myers, these are the most important of the MBTI groupings, because they represent the "essence of Jung's comprehensive theory" (Myers and McCaulley, 1985:12,33). The S-N scale score shows how the individual perceives information, while the T-F score indicates how he or she prefers to process it. Referring back to Curry's learning style model (see Figure 1), cognitive style is the second component of individual learning style and is represented by the second layer of the "onion."

TABLE 1
MBTI DOMINANT FUNCTIONS

<u>TYPE</u>	<u>DOM</u>	<u>TYPE</u>	<u>DOM</u>	<u>TYPE</u>	<u>DOM</u>	<u>TYPE</u>	<u>DOM</u>
ISTJ	Si	ISTP	Ti	ESTP	Se	ESTJ	Te
ISFJ	Si	INTP	Ti	ESFP	Se	ENTJ	Te
INFJ	Ni	ISFP	Fi	ENFP	Ne	ESFJ	Fe
INTJ	Ni	INFP	Fi	ENTP	Ne	ENFJ	Fe

The small e or i after each capitalized function identifies whether the function is (i)ntroverted or (e)xtraverted.

(Campbell, 1992)

Table 2 shows how the four MBTI cognitive style types compare in terms of preferences for perceiving and processing information, as well as general characteristics and occupational preferences.

The Sensing-Thinking (ST) type is interested in facts, because they can be collected directly with the five senses. STs process these facts through impersonal analysis and step-by-step logical thought. STs, in theory, are therefore practical, logical, and impersonal (Myers and McCaulley, 1985:33).

People who are Sensors-Feelers (SFs) also prefer perceiving information with the five senses, but are much more subjective in how they process it. They trust their feelings concerning the relative importance of the

information they collect, and they like facts about people more so than facts about things. SFs tend to be "sympathetic and friendly" (Myers and McCaulley, 1985:34).

Like SFs, Intuition-Feeling (NF) types also are usually warm and friendly because they rely upon feeling for processing information. They differ, however, in the way they tend to perceive information. NFs focus more on possibilities, symbolism, and theories, rather than concrete facts. This type is often "enthusiastic as well as insightful" (Myers and McCaulley, 1985:35).

Intuitive-Thinkers (NTs) also prefer to focus on possibilities, theories, and symbols, but, like STs, they process this information in an objective, logical manner. NTs are often both practical and insightful (Myers and McCaulley, 1985:35).

MBTI Applications. According to Myers and McCaulley, the MBTI has been applied in several fields, such as counseling, teamwork, business, and education. In counseling, the MBTI is used to help individuals find direction for their lives and assist couples and families in learning the value of their differences and similarities. Individuals can be shown their tendencies and be aware enough of their types to attempt to develop their powers of perception and judgement. In the area of teamwork, team member selections can be diversified by type, differences can be recognized, and type strengths can be utilized to contribute to the group as a whole (1985:4).

TABLE 2
MBTI COGNITIVE STYLE TYPE COMPARISONS

<u>Sensing- Thinking</u>	<u>Sensing- Feeling</u>	<u>Intuitive- Feeling</u>	<u>Intuitive- Thinking</u>
Perceives information by focusing on facts	Perceives information by focusing on facts	Perceives information by focusing on possibilities	Perceives information by focusing on possibilities
Processes information objectively	Processes information subjectively	Processes information subjectively	Processes information objectively
Practical, matter-of-fact	Sympathetic, friendly	Enthusiastic, insightful	Logical, ingenious
Display good technical skills w/facts and objects	Good at practical help and services for people	Able to understand and communicate well with people	Prefers theoretical and technical developments

(Myers and McCaulley, 1985:35)

Many businesses, including Apple, AT&T, Citicorp, Exxon, General Electric, Honeywell, 3M, and Transamerica, have used the MBTI in management development programs to help executives better understand themselves and their co-workers. These organizations have found that, by joining the theories of motivation and MBTI types, many of their worker-related problems can be more easily solved (Moore, 1987:75).

Education is another area where the applications of the MBTI have been emphasized. Myers and McCaulley see type comprehension helping teachers generate teaching methods to

meet the different needs and motivation levels of their students (1985:4). Lawrence gives three examples of teachers whom, having been made aware of the type differences in their classrooms, developed projects and formed teams that had enough varied goals and duties to interest all sixteen psychological types (1982:47-49).

Instructional and Learning Preference

According to Curry's model, instructional and learning preferences constitute the fourth and final component of individual learning style. This component is the most dynamic of the four and Curry feels its volatility makes it very difficult to accurately identify and measure. Also, instructional and learning preferences are influenced by all of the other three individual learning style components (Claxton and Murrell, 1987:7).

Kemp, a researcher in the field of instructional design, emphasized the importance of considering the preferences of learners when planning which instructional methods to employ:

Some students find certain methods of learning more appealing and effective than others. Some profit more from a visual approach; others from verbal (listening and/or reading) experiences; and still others from physical activities and the manipulation of objects. (Kemp, 1977:19)

Campbell developed the Learning Style Survey (LSS) with the objective of identifying and measuring student preferences for what he terms "learning methods, techniques,

and devices (MTDs)" for adult undergraduate and graduate students (1992). Campbell began his research into learning styles in 1984, discovering there was very little prior research in MBTI literature dealing with adult learning and teaching methodology. He noted that Morgan's theories of learning preferences by psychological types (presented in the next section, see Figure 5) are not necessarily what he had experienced in the classroom. Campbell reviewed published teaching methods, interviewed several teachers considered successful in their various fields, and tested students he came into contact with concerning their preferred or non-preferred MTDs (1993). Through this research, Campbell first developed a large list of possible MTDs, and then he refined it into the LSS. The LSS requires each respondent to rank order his or her top five "most preferred" and "least preferred" MTDs from 34 possible choices (1992). The list of thirty-four MTDs is shown at Figure 3.

Like MBTI cognitive style types, the LSS MTDs are of prime importance to this thesis and will serve as the measure for the fourth component of learning style, instructional and learning preferences.

Relating MBTI Types to Learning Preferences

There have been several efforts to discover the relationships between MBTI types and individual instructional and learning preferences. However, none of

- | | |
|----------------------------------|----------------------------|
| 1. Blackboard | 18. Independent study |
| 2. Case study | 19. Interview |
| 3. Computer-assisted instruction | 20. Laboratory |
| 4. Confer with other students | 21. Lecture |
| 5. Debate | 22. Memorization |
| 6. Demonstration | 23. Observation |
| 7. Discuss with instructor | 24. Oral Reports |
| 8. Drill and repetition | 25. Peer Teaching |
| 9. Examinations | 26. Pop Quiz |
| 10. Exercises | 27. Programmed instruction |
| 11. Films/videotapes | 28. Reading |
| 12. Flipcharts | 29. Role play |
| 13. Games | 30. Simulations |
| 14. Group discussion | 31. Term paper |
| 15. Group projects | 32. Tutorial |
| 16. Guest lecturer/speaker | 33. Viewgraphs |
| 17. Homework assignments | 34. Worksheets |

Figure 3. The Learning Style Survey's Thirty-Four "Methods, Techniques, and Devices" (MTDs)

these previous studies have attempted to discover and empirically support links between student MBTI cognitive style types and their preferences for very specific learning experiences, such as the LSS's learning MTDs.

Isabel Myers conducted a study designed to determine academic subject preferences by MBTI type. She used Form G of the MBTI containing the question, "Which do you like best - math, English, science, history, practical skills, music, or art?" Figure 4 shows the results of her study by MBTI type. Listed under each of the sixteen types are the academic subjects which were "significantly" chosen by the respondents (Myers and McCaulley, 1985:100).

The Extraversion-Introversion Scale. Lawrence found that most of the studies examining MBTI types and learning

ISTJ Mathematics Practical Skills	ISFJ Practical Skills	INFJ Art English Music	INTJ Science
ISTP Mathematics Practical Skills	ISFP Practical Skills	INFP Art English Music	INTP Art Science
ESTP History Mathematics Practical Skills	ESFP History	ENFP Art English Music	ENTP Art Science
ESTJ Mathematics Practical Skills	ESFJ Mathematics Music	ENFJ Art English Music	ENTJ English Science

Figure 4. Academic Subject Preferences by MBTI Type (Myers and McCaulley, 1985:110)

preferences concentrate on the four dichotomous MBTI scales separately. Smith and Irely, utilizing the extraversion-introversion (E-I) scale, found that college students in a self-paced program tend to choose learning activities consistent with their outward approach to the world. Introverts significantly selected supplementary lectures from the instructor and extraverts chose activities that involved less formal dialogue, with advanced students often acting as course monitors. This is consistent with another

study, which found extraverts in a military training course having a higher dropout rate than introverts, until the course was changed to allow for two or three individuals to work together in a group. Lawrence reported two other studies with similar results, concluding from the four studies that there is a correlation between the E-I preference and learning style, with extraverts preferring dialogue and introverts staying away from group situations as best they can (1984:5-6).

Another study investigated the performance of certain polar preferences in relation to changing levels of complexity in tasks, which linked the variability of extraversion or introversion with a measure of a student's drive or anxiety level. The research found that "high-drive" introverts and "low-drive" extraverts were lacking in retaining verbally complex material; extraverts were better on simple or complex psychomotor tasks; and no differences were found in retention of verbal material (Claxton and Murrell, 1987:15).

A later study, taking a specific look at type and learning preferences in a year-long language program, confirmed these results. The study consisted of 20 students in the program, with the results based on student involvement and instructor observation. The group was made up of 12 of the 16 MBTI types. There were three each ESTJs and ENTJs, two each ISTJs, INTJs, INFPs, and INTPs, and one each ISFJ, ISTP, ESFP, ENTP, ESFJ, and ENFJ. The study

concluded that extraverts much preferred indirect teaching strategies, especially social strategies that emphasized informal sessions with more group interaction, while introverts favored the cognitive strategy of formal, structured methods (Ehrman and Oxford, 1990:313-315,318).

The Sensing-Intuition Scale. Three separate studies into the different learning styles of the sensing-intuitive (S-N) preference establish results which, according to Lawrence, are consistent with type theory. Intuitive types respond well to instructors calling for determination of relationships and possibilities, while sensors are more inclined to positively react to instruction that deals with sequential observation of a process. A survey by McCaulley and Natter found similar differences between the sensing and intuitive types of secondary school students. The study reports sensing types find television helpful, spend 1-2 hours a week in non-required reading, and proceed in an orderly fashion. Intuitive types, on the other hand, enjoy self-instruction, spend 3-9 hours a week in non-required reading, and tend to let course work pile up and then "cram" at the end (Lawrence, 1984:8). Ehrman and Oxford found sensors strongly favor memory strategies to learn a foreign language, while intuitive types were more likely to use compensation strategies, such as using linguistic clues or gestures to get to a level of understanding (1990:313,319).

Further studies show that intuitive types consistently have higher results on reading and writing aptitude tests,

consistent with the theory that they can better convert symbols to meaning, whereas the sensing type has less natural interest in reading, but is much more interested in facts and details than an intuitive type (Claxton and Murrell, 1987:15-16). Intuitive types consistently have higher scores when reading is used as a learning tool and studies have subsequently found that introverted intuitives (IN--) tend to score higher in reading speed and comprehension than extraverted intuitives (EN--), with extraverted sensing (ES--) types scoring the lowest of all the type preferences (Lawrence, 1984:5).

The Thinking-Feeling Scale. Studies looking at the thinking/feeling preferences find significant differences of learning styles between the two types. Thinking types, as shown by a collection of studies, tend to avoid interpersonal issues and avoid involvement in group activity when given the choice, as was the case in one study that looked at a self-paced educational program. An optional group help session was available and attendance by feeling types was much more frequent than by thinkers. From another study, which examined short-term memory, thinkers, especially introverted thinkers, were much better at remembering digits and geometric shapes than feeling types. The feelers, however, proved superior, especially extraverted feelers, at recalling faces and names. (Lawrence, 1984:9) Another research team called the learning style differences between thinking and feeling

types "dramatic" and "the most striking complementarity between poles of any MBTI scale in this study." Thinkers showed the strongest preference of any type for what the researchers termed "cognitive," which is repetition, detailed analysis, creating structure for both input and output, and rejecting social strategies that feelers find very important (Ehrman and Oxford, 1990:320).

The Judging-Perceiving Scale. Research findings concerning the judgement-perception (J-P) scale have not been as conclusive as those for the three other scales. While one study found significant differences between the polar regions of the first three scales, a similar correlation between judgers and perceivers did not exist. Other studies have shown trends involving these two preferences, with judging types less likely to drop out of school, more likely to complete their work earlier, and more responsive to traditional teaching methods than perceiving types. In a study at Ohio State University, perceivers chose a new individual study program at a significantly higher rate than judgement types (Lawrence, 1984:6,10-11). Ehrman and Oxford also found differences in the learning styles of judgers and perceivers, concluding that the two were opposites in their use of compensation, preferred by the judging type, and social strategies, which the perceiving type best responds to (1990:321).

Other Findings. As reported by Lawrence, Morgan developed a theory which links the sixteen MBTI types to

classroom learning preferences (1982:49). Figure 5 summarizes her proposed relationships. Morgan arrived at her theory as a result of a synthesis of many other MBTI studies. She describes sensing types as "linear learners" and intuitive types as "global learners." Linear refers to a sequential approach to learning tasks, whereas the global learners approach and look at the learning task as a whole. Although certain aspects have been supported by one field research study, this theory has not yet been completely tested empirically (Lawrence, 1982:50).

Morgan's theory, which was developed through research involving adolescents, served as the basis for Campbell's development of his learning MTDs in adults. Campbell's MTDs are designed to be more specific than Morgan's categories of classroom learning preferences (Campbell, 1993).

Summary

This chapter reviewed the literature relevant to this research. The first section presented a model of learning style. Next, the two learning style components of interest to this study, cognitive style and learning and instructional preferences, were reviewed in separate sections. Finally, the last section presented the findings of previous studies which have examined the relationships between the two components.

Chapter III will describe the methodology for this research.

ESTP Linear learner; needs help organizing (SP) Needs to know why before doing something (S) Likes group projects, class reports, team comp (E) Likes direct experience (S) Likes audiovisuals (S) May like lecture (T)	ESFP Linear learner; needs help organizing (SP) Needs to know why before doing something (S) Likes group projects, class reports, team comp (E) Likes direct experience (S) Likes audiovisuals; practical tests (S) Needs well-defined goals (S)
ENFP Global learner; needs choices and deadlines (NP) Likes seminars (EN) Likes reading, if can settle down long enough (EN) Likes autonomy (NP) Likes harmonious group work, class reports, team comp(EF) Needs help organizing (NP)	ENTP Global learner; needs choices and deadlines (NP) Likes seminars (EN) Likes reading, listening (N) Prefers open-ended instr (N) Likes autonomy (NP) Considers theory first, then applications (N) Likes paper-pencil tests(NT)
ESTJ Linear learner w/strong need for structure (SJ) Needs to know why before doing something (S) Likes direct experience (S) Likes group work; team comp; class reports (E) Likes audiovisuals; practical tests (S) May like lecture (T)	ESFJ Linear learner w/strong need for structure (SJ) Needs to know why before doing something (S) Likes direct experience (S) Values harmonious group work class reports; team comp(E) Likes audiovisuals; practical tests (S) Needs well-defined goals (S)
ENFJ Global or linear learner(NJ) Likes seminars (EN) Likes reading if can settle down long enough (ENF) Likes harmonious group work, class reports (EF) Likes listening (N) Likes pencil-paper tests (N) Prefers open-ended instr (N) Considers theory first, then applications (N)	ENTJ Global or linear learner(NJ) Likes seminars (EN) Likes reading if can settle down long enough (EN) Likes group projects, class reports, team comp (E) Likes listening (N) Likes pencil-paper tests (N) Prefers open-ended instr (N) Considers theory first, then applications (N)

(Continued)

ISTJ Linear learner with strong need for order (SJ) Likes direct experience (S) Likes audiovisuals (S) and lectures (I) Enjoys working alone (I) Prefers practical tests (S) Likes well-defined goals (S)	ISFJ Linear learner with strong need for order (SJ) Likes direct experience (S) Likes audiovisuals (S) and lectures (I) Enjoys working alone (I) Likes practical tests (S)
INFJ Can be global or linear (NJ) Considers theory first, then applications (N) Enjoys working alone (I) Prefers open-ended instruction (N) Needs harmony in group work (F)	INTJ Can be global or linear (NJ) Considers theory first, then applications (N) Enjoys working alone (I) Prefers open-ended instruction (N) Good at paper and pencil tests (NT)
ISTP Linear learner, needs help in organizing (SP) Likes direct experience (S) Likes lectures and audiovisuals (S) Enjoys working alone (I) Wants logically-structured, efficient materials (IT)	ISFP Linear learner, needs help in organizing (SP) Likes direct experience (S) Likes audiovisuals and practical tests (S) Enjoys working alone (I) Needs well-defined goals (S) Needs harmony in group projects (F) Needs sensitive teacher (IF)
INFP Global learner; may need help organizing (NP) Likes reading; listening (N) Considers theory first, then applications (N) Needs harmony in group work (F) Prefers open-ended instr (N) Enjoys working alone (I) Likes autonomy (NP)	INTP Global learner; may need help coming to closure (NP) Likes reading; listening (N) Considers theory first, then applications (N) Good at paper and pencil tests (NT) Prefers open-ended instr (N) Enjoys working alone (I) Likes autonomy (NP)

Figure 5. Classroom Learning Preferences by MBTI Type
(Lawrence, 1982:52-53)

Chapter III. Methodology

This chapter outlines the methodology used to test the research question and six investigative questions. To guide this discussion, separate sections on the population, data collection plan, survey instruments, variable definitions, and data analysis plan are presented.

Population

The population of interest for this study includes all students who completed a Masters of Science degree program with the School of Systems and Logistics at AFIT during the period 1988 to 1992. All were full-time students. Over ninety-five percent were employed by the Department of Defense (DOD) as either military officers or civil service employees. Fewer than five percent were military officers from allied countries.

A nonprobability method was used to obtain the sample for this research.

Data Collection Plan

All data were collected through the use of the Myers-Briggs Type Indicator (MBTI) and the Learning Style Survey (LSS). The MBTI was used to identify student cognitive style types and the LSS measured student preferences for learning methods, techniques, and devices (MTDs). Both surveys were administered to students as pre-tests and post-tests. The pre-tests were completed by the students during

the orientation period, prior to the start of any graduate school classes. The post-tests were administered shortly before the students graduated, approximately fifteen months later.

Survey Instruments

The MBTI. The Form G survey instrument was used. The students marked their answers to the MBTI questions on a computer-readable answer sheet. Each individual answer sheet was scored by a computer program which generated individual results. These results classified each student into one of the sixteen possible MBTI psychological types. The report also provided the individual preference strength scores along each of the four two-dimensional MBTI scales: Extraversion-Introversion, Sensing-Intuition, Thinking-Feeling, and Judging-Perception. The report listed administrative and categorical data, including the student's name, gender, birth date, and the date the survey was completed.

The LSS. The LSS was developed as a collection instrument to measure student preferences for learning MTDs (Campbell, 1992). It requires each student to rank order his or her five "most preferred" and five "least preferred" learning MTDs from thirty-four possible choices. The LSS does not provide individual feedback, rather it is designed to gather individual responses for research purposes.

Definitions of the Variables

Cognitive Style Types. This is a qualitative variable and is the independent variable for the research question. For each student, the cognitive style type is represented by the MBTI cognitive style type. This is a two-letter description which indicates the student's preference on the two two-dimensional MBTI scales of Sensing-Intuition (S-N) and Thinking-Feeling (T-F). There are two measurements of this variable for each student as provided by the pre-test and post-test MBTI results.

Preferences for Learning MTDs. This variable is also qualitative and is the dependent variable for the research question. Due to the pre-test and post-test LSSs, there are also two sets of measurements for this variable for each student.

Data Analysis Plan

Once all surveys were scored, the data were used to create two spreadsheets, one for the pre-test data and the other for the post-test data. Each student represented one row in each spreadsheet. Five other spreadsheet programs were developed to perform all required data analyses and calculations. The Quattro Pro (4.0) spreadsheet program was employed throughout.

From the spreadsheets, the following sample distributions were produced:

- (1) The pre-test distribution of student cognitive style types.
- (2) The overall pre-test distribution of the "most preferred" learning MTDs.
- (3) The overall pre-test distribution of the "least preferred" learning MTDs.
- (4) From the pre-tests, the two distributions of "most preferred" and "least preferred" learning MTDs for each of the four cognitive style types.
- (5) The same distributions listed above were produced based on the post-test results.

Commonly accepted statistical procedures were employed to analyze the data. Throughout the study, all tests of hypotheses used an .05 level of significance. The following is a discussion of the methods of analysis that were used to answer the investigative questions.

Analysis Procedures for Investigative Question 1. *What is the reliability and validity of the MBTI and LSS?*

The MBTI was developed in 1962 and, since that time, has been tested by numerous independent studies for reliability and validity. Chapter IV of this thesis presents a summary of the findings concerning the reliability and validity of the MBTI.

The LSS was tested as part of this research for stability. The results are described in Chapter IV, along with a description of the manner in which the instrument's

validity was addressed during its construction and revisions.

For Investigative Questions 2 through 6, the Chi-Squared Multinomial Distribution Analysis Test was used to compare sampling distributions. This test compares two distributions to one another and tests whether or not they are significantly different. One distribution provides expected values and the other distribution represents observed values. The basic assumption required for this test is that the expected count for each possible outcome is equal to or greater than five. This assumption was met for all distributions which were tested.

Analysis Procedures for Investigative Question 2. *Is the distribution of cognitive style types, as measured by the pre-test MBTI, different from that of the general population?*

All data for this question came from MBTI results. The pre-test sample distribution of cognitive style types was compared to an independent estimate of the cognitive style type distribution for the general population. The estimate was obtained from a study by the Values and Lifestyles (VALS) program of SRI International which was conducted in 1983 (McCaulley and others, 1985:4-7). The SRI estimate was chosen for this research because it is a randomly stratified sample of the U.S. population. The VALS distribution provided the expected values for the test and the sample

distribution of student cognitive style types represented the observed values.

Analysis Procedures for Investigative Question 3. *As measured by the pre-test MBTI and LSS, what are the relationships of the cognitive style types to preferences for learning MTDs?*

The analysis procedures for this question were completed in four steps. First, the pre-test sample distributions of learning MTD preferences ("most" and "least") for the total sample and each cognitive style type were analyzed to determine whether or not preferences exist. Next, the distributions which showed that preferences do exist were analyzed to identify those MTDs which were significantly "most preferred" or "least preferred". For the next step, all possible pairs of learning MTD preference distributions by cognitive style type were compared for a total of 12 tests of hypotheses. Finally, for all pairs of distributions showing statistical differences, the learning MTDs were analyzed to determine which were significantly different.

Analysis Procedures for Investigative Question 4. *Do cognitive style types change during the time between the pre-test and post-test MBTI?*

For this question, the pre-test distribution of cognitive style types was compared to the post-test distribution of the same variable. The pre-test distribution provided the expected values and the post-test

distribution represented the observed values. This question required only one test of hypotheses.

Analysis Procedures for Investigative Question 5. *Do preferences for learning MTDs change during the time between the pre-test and post-test LSS?*

The procedures for this question were identical to those for Investigative Question 4. The overall pre-test and post-test distributions of learning MTD preferences ("most" and "least") were compared.

Analysis Procedures for Investigative Question 6. *If there were significant relationships between cognitive style types and preferences for learning MTDs, as measured by the pre-test MBTI and LSS, have these relationships changed significantly when compared to the post-test MBTI and LSS measurements?*

For this question, there were eight tests of hypotheses. Each of the pre-test distributions of learning MTDs ("most preferred" and "least preferred") by cognitive style type was compared to its post-test counterpart. The pre-test distributions provided the expected values and the post-test distributions represented the observed values.

Summary

This chapter outlined the methodology which was used to analyze the data for this research. The next chapter describes the actual analysis of the data and results of the statistical tests.

Chapter IV. Data Results and Analysis

This chapter presents the data results and analysis. First, the population and sample demographic information are reviewed. The remaining six sections of the chapter are devoted to answering each of the investigative questions.

Demographic Analysis

The population for this research consists of all students completing a Master of Science degree at the School of Systems and Logistics, Air Force Institute of Technology, during the period 1988 through 1992.

All population members were asked to participate in this research and 70.91% (529) did. Table 3 presents the demographic frequencies for the sample. Although the four age groups span a total of 21 years, 83.93% (444) of the sample members were 34 years of age or younger. Three categories are used to give an indication of the students' varying backgrounds. The majority of the sample members were U.S. military officers. Student category information is not available for the 1992 class. Females represent 12.85% (68) of the sample, compared to 12.47% of the population. A composite sample member would be a male, U.S. military officer between the ages of 24 and 34 years.

Because a nonprobability method was used to obtain the sample, a Chi-Squared Goodness of Fit test was calculated to compare the sample frequency distributions to those of the

TABLE 3
SAMPLE DEMOGRAPHIC FREQUENCY DISTRIBUTIONS

<u>Age Group</u>	<u>Number</u>	<u>Percent of Total</u>	<u>Number Females</u>	<u>Percent Female</u>
24 to 29	27	51.79%	39	14.23%
30 to 34	170	32.14%	17	10.00%
35 to 39	74	13.99%	8	10.81%
40 to 44	11	2.08%	4	36.36%
Totals	529	100.00%	68	12.85%

<u>Student Category</u>	<u>Number</u>	<u>Percent of Total</u>
U.S. Military Officer	398	89.04%
DOD Civilian Manager	29	6.49%
International	20	4.47%
Totals	447 [*]	100.00%

^{*} Student category data for the 1992 class (82 sample members) is not available.

population. Both the age group and student category distributions were tested. Figures 6 and 7 show the analyses procedures and results. As the tests show, the research sample compares favorably to the population in terms of both distributions.

Investigative Question 1

What is the reliability and validity of the MBTI and LSS?

To answer this investigative question, a different set of procedures was used for each of the survey instruments. The MBTI has been tested extensively for reliability and validity. A summary of the findings is presented here. The LSS was tested for reliability as part of this research.

H₀: $p_{0,1} = p_{E,1}$, $p_{0,2} = p_{E,2}$, $p_{0,3} = p_{E,3}$, and $p_{0,4} = p_{E,4}$

...where $p_{0,i}$ is the sample frequency and $p_{E,i}$ is the population frequency for each age group.

H_a: At least one of the sample frequencies does not match the population frequency.

$$\text{Test Statistic: } \chi^2 = \sum_{i=1}^4 [n_i - E(n)_i]^2 / E(n)_i$$

...where $n_i = np_{0,i}$, the sample number for each age group, and $E(n)_i = np_{E,i}$, the expected number for each age group based on the population frequency. The total sample size is n .

Critical χ^2 Value for $df = 3$: $\chi^2_{.05} > 7.81473$

Test Statistic Value: $\chi^2 = 1.0284$

Conclusion: Fail to reject H₀.

Figure 6. Chi-Squared Goodness of Fit Test Comparing the Sample Age Group Frequencies to Those of the Population

Validity was considered in its construction and revisions. Data concerning the reliability and validity of the LSS are presented later in this section.

Reliability of the MBTI. The reliability of MBTI findings lie in the consistency of the answers to its battery of questions (Myers and McCaulley, 1985:164). To establish this consistency, each MBTI question is focused on only one of the four polar areas. The responses are weighted at 0, 1, or 2 points. Responses that best predict a type with a prediction ratio of 72% or higher carry a weight of 2, while items in the 63% to 71% ratio range carry a weight of 1 (Myers and McCaulley, 1985:3). Internal

Ho: $p_{0,1} = p_{E,1}$, $p_{0,2} = p_{E,2}$, and $p_{0,3} = p_{E,3}$

...where $p_{0,i}$ is the sample frequency and $p_{E,i}$ is the population frequency for each student category.

Ha: At least one of the sample frequencies does not match the population frequency.

$$\text{Test Statistic: } \chi^2 = \sum_{i=1}^3 [n_i - E(n)_i]^2 / E(n)_i$$

...where $n_i = np_{0,i}$, the sample number for each student category, and $E(n)_i = np_{E,i}$, the expected number for each category based on the population frequency. The total sample size (less the 1992 class) is n .

Critical χ^2 Value for $df = 2$: $\chi^2_{.05} > 5.99147$

Test Statistic Value: $\chi^2 = 0.7403$

Conclusion: Fail to reject Ho.

Figure 7. Chi-Squared Goodness of Fit Test Comparing the Sample Student Category Frequencies to Those of the Population

control is maintained through split-half reliability, where similar questions are split into two random halves. The Spearman-Brown prophecy formula correction has shown a high correlation between the halves, leading to the instrument's developers' claim of a high degree of internal reliability (Myers and McCaulley, 1985:165-169).

To establish reliability for the instrument system, the MBTI has gone through test-retest procedures to determine if an individual will choose the same four preferences on the retest as he or she chose on the original test. Published results have been favorable. When changes occur in the retest, they most likely are in one of the areas where the

original preference score was low (Myers and McCaulley, 1985:170-171). Independent researchers have found the MBTI to be satisfactorily reliable for test-retest procedures (Sewall, 1986:14).

Validity of the MBTI. Myers and McCaulley attempted to establish external, content validity by correlating MBTI results with other instruments seeking similar information. The authors of the MBTI manual compared MBTI results to 33 other measures assessing similar attributes of individuals. The results indicate that the MBTI compares favorably to these measures, with correlation between aspects of one measure with one or more of the MBTI's eight preferences at a coefficient of correlation (r), showing a linear relationship between the two items, of .20 or higher at a statistical probability of .01 (1985:175-223). Independent researchers have reached similar conclusions.

Lawrence synthesized the results of several researchers' investigations of the MBTI's validity. The researchers attempted to correlate MBTI results with several other like measurements including the Edwards Personal Preference Schedule and the Personality Research Inventory. Lawrence concludes that the results are "clearly consistent with the theory devised by Jung" (1984:2,13).

Internal validity is established through type distributions of MBTI data on groups of individuals. Some occupations have significantly more of certain types than they do of others, giving the MBTI some predictive value and

adding to its construct validity (Myers and McCaulley, 1985:176). For instance, Gaster, Tobacyk, and Dawson studied male retail store managers, and, as expected, found the concentration of managers with TJ results made up over 75 percent of the 316 respondents (Myers and McCaulley, 1985:90).

Reliability of the LSS. A test-retest of the LSS instrument was conducted using, as a sample group, forty-three military officers and enlisted members attending a two-week course in military logistics at AFIT. The respondents completed the LSS in the middle of the first week, and then retested five days later. With five "most preferred" and five "least preferred" learning MTDs, there were a total of ten possible matches between the test and retest for each respondent. Out of the sample group total of 430 possible matches, there were 253 actual matches, for a 58.84 percent test-retest reliability, which demonstrates adequate instrument stability considering the volatile nature of the construct that is measured and when compared to another learning style measurement instrument (the Canfield Learning Styles Inventory) which measures a similar construct (Sewall, 1986:42-43). Appendix A shows the complete test-retest results and calculations.

Validity of the LSS. Content validity was addressed by Campbell in the initial design and subsequent revisions of the LSS. The two primary concerns were the scope of the 34 learning MTDs and the description of each MTD. The LSS was

designed to capture all of the aspects of different learning MTDs and apply those results to the teaching of adult students. Campbell arrived at the final list of 34 MTDs from responses of graduate and undergraduate instructors and feedback from students. Each of the 34 MTDs are described using commonly understood terms and these descriptions have been revised when necessary (Campbell, 1993). Campbell's approach combined two widely recommended methods for building content validity into a measurement instrument (Emory and Cooper, 1991:180). First, he carefully defined the topic of concern, the items to be scaled, and the scales to be used. He then solicited and received feedback from his peers and members of the instrument's target population. From the results of this process, he judged the LSS to contain content validity.

Investigative Question 2

Is the distribution of cognitive style types, as measured by the pre-test MBTI, different from that of the general population?

The sample distribution of AFIT student MBTI cognitive style types is shown at Table 4. Over half (278) of the sample members are Sensing-Thinking types, and nearly thirty percent (155) are Intuitive-Thinkers. Viewing the two dichotomous scales separately, 64.27 percent (340) of the sample members are Sensors and 35.73 percent (189) are

TABLE 4
SAMPLE DISTRIBUTION OF MBTI COGNITIVE STYLE TYPES

MBTI Type	Number	Relative Frequency	Males	Percent Male	Females	Percent Female
ST	278	52.55%	248	89.21%	30	10.79%
SF	62	11.72%	50	80.65%	12	19.35%
NT	155	29.30%	135	87.10%	20	12.90%
NF	34	6.43%	28	82.35%	6	17.65%
Totals	529	100.00%	46	87.15%	68	12.85%

$H_0: p_{0,1} = p_{E,1}, p_{0,2} = p_{E,2}, p_{0,3} = p_{E,3}, \text{ and } p_{0,4} = p_{E,4}$

...where $p_{0,i}$ is the sample frequency and $p_{E,i}$ is the expected frequency for each MBTI cognitive style type.

H_a : At least one sample frequency does not equal the the expected frequency, based on the SRI estimates.

Test Statistic: $\chi^2 = \sum_{i=1}^4 [n_i - E(n)_i]^2 / E(n)_i$

...where $n_i = np_{0,i}$, the observed count, and $E(n)_i = np_{E,i}$, the expected count for each MBTI cognitive style type. The total number of sample members equals n .

Critical χ^2 Values for $df = 3$:

$\chi^2_{.05}$	>	7.815
$\chi^2_{.01}$	>	11.345
$\chi^2_{.001}$	>	16.273
$\chi^2_{.0001}$	>	21.01

Test Statistic Values: Overall Sample: $\chi^2 = 75.4603$
Sample Males: $\chi^2 = 43.0433$
Sample Females: $\chi^2 = 78.235$

Conclusions: Reject H_0 for all three distributions.

Figure 8. Chi-Squared Analyses from Comparing the Sample MBTI Cognitive Style Type Distributions to the SRI Estimates of the General Population

Intuitives, while 81.85 percent (433) are Thinkers compared to 18.15 percent (96) who are Feelers.

The overall sample distribution and the sample distributions for males and females were compared to the SRI International Values and Lifestyles (VALS) program's estimates of the general population distributions of MBTI cognitive style types. The results of the chi-squared analyses for these comparisons are shown at Figure 8. As the test results show, all three sample distributions are statistically different from their SRI counterparts at the .0001 level of significance. Therefore, one can conclude that the composition of cognitive style types as measured by the MBTI for the sample is different than that of the general population. The complete analyses calculations and results for these tests are shown at Appendix B.

For the total sample and the sample males, the observed numbers of STs differ only slightly from the expected numbers. All other differences are significant. For all three sample distributions, the most statistically significant differences between the observed and expected numbers occur for cognitive style type NT. The observed numbers exceed the expected numbers in all three distributions.

Investigative Question 3

As measured by the pre-test MBTI and LSS, what are the relationships of the cognitive style types to preferences for learning MTDs?

This question was answered using four steps, each involving a different chi-squared analysis procedure.

First, both learning MTD preference distributions ("most preferred" and "least preferred") for the total sample and each of the four cognitive style types (ten distributions in all) were tested to determine whether or not preferences exist (Figure 9). The null hypothesis for this test states that all thirty-four MTDs are preferred equally within the distribution, while the alternative hypothesis is that at least one MTD is preferred over ("most" or "least") the others. The purpose of this test was to identify the distributions for which preferences exist for further analysis.

As Figure 9 shows, the null hypothesis was rejected for all ten distributions ("most preferred" and "least preferred" for the total sample and four cognitive style types) at the .0001 level of significance. The complete analyses calculations and results for these tests are at Appendix C. The test results indicate that learning MTD preferences exist for all distributions. Therefore, all ten distributions were subjected to additional analyses, as is described next.

$H_0: p_1 = p_2 = p_3 = \dots = p_{34} = 1/34$ (No Preference)

... where p_1 is the probability that MTD A is preferred, p_2 is the probability that MTD B is preferred, and so on through p_{34} which is the probability that MTD AH is preferred.

H_a : At least one of the probabilities exceeds $1/34$.

Test Statistic: $\chi^2 = \sum_{i=1}^{34} [n_i - E(n)_i]^2 / E(n)_i$

...where $n_i = np_i$, the observed number for each MTD, and $E(n)_i = 1/34n$, the expected number for each MTD. The total number of students in the group multiplied by five (the number of "most preferred" and "least preferred" MTD possible choices for each student) equals n .

Critical χ^2 Values for $df = 33$:

$\chi^2_{.05}$	>	47.40
$\chi^2_{.01}$	>	54.775
$\chi^2_{.001}$	>	63.86
$\chi^2_{.0001}$	>	71.87

χ^2 Test Statistic Values:

Group	χ^2 "Most Preferred"	χ^2 "Least Preferred"
Total Sample	1504.16	1311.48
ST	799.55	657.39
SF	175.65	162.93
NT	531.31	487.03
NF	118.80	108.80

Conclusions: For all distributions, H_0 is rejected at the .0001 level of significance.

Figure 9. Chi-Squared Analyses of Learning MTD Preference Distributions for the Total Sample and the Cognitive Style Types

The next step involves chi-squared analyses to isolate the specific learning MTDs which are preferred ("most" and "least") by the total sample and each of the cognitive style types. For each of the ten distributions, each learning MTD was tested using the procedure shown at Figure 10. There were a total of 340 tests of hypotheses. The null

Ho: $p = 5/34$ (No preference)

...where p is the proportion of group members who chose the learning MTD as one of the five "most preferred" or "least preferred."

Ha: $p \neq 5/34$

Test Statistic:

$$\chi^2 = \frac{[n_i - E(n)_i]^2}{E(n)_i} + \frac{[(n - n_i) - (n - E(n)_i)]^2}{(n - E(n)_i)}$$

...where n_i = the number of group members who selected the MTD as preferred and $E(n)_i = 5/34n$, the expected number of group members who select the MTD as preferred if Ho is true. The total number of group members equals n .

Critical χ^2 Values for df = 1:	$\chi^2_{.05}$	>	3.84146
	$\chi^2_{.01}$	>	6.6349
	$\chi^2_{.001}$	>	10.83
	$\chi^2_{.0001}$	>	15.045

Test Statistic Values: Listed at Appendix D.

Conclusions: As shown at Tables 5 and 6.

Figure 10. Chi-Squared Analysis Procedure for Isolating Preferred Learning MTDs

hypothesis states that the proportion of group members who select the learning MTD as preferred is 5/34 (each group member selects five MTDs from thirty-four possible choices), indicating that the MTD is not significantly preferred by the group. The alternative hypothesis is that the proportion of the group members who select the MTD as preferred is not equal to 5/34, but may be greater or less. However, because the "most preferred" and "least preferred" distributions are analyzed separately, only those MTDs which

have proportions greater than 5/34 are of interest in answering this investigative question. All that can be said concerning those MTDs with proportions significantly below 5/34 is that they are significantly not preferred ("most" or "least"). Appendix D shows the complete analyses calculations and results for these tests.

Table 5 shows all the learning MTDs which were significantly "most preferred" by the total sample and each of the cognitive style types. This table shows only the levels of statistical significance. The specific values and calculations for all learning MTDs are shown at Appendix D.

Two learning MTDs, "Demonstration" and "Group Discussion", were preferred by the total sample and all cognitive style types at the .0001 level of significance, indicating that these MTDs are generally "most preferred" by all types. Two others, "Discuss w/Instructor" and "Confer w/Other Students", were preferred by the total sample and three of the four cognitive style types (ST, SF, and NT) at levels of significance varying between .01 and .0001.

For the Sensing-Thinking cognitive style type, a total of eleven learning MTDs were significantly "most preferred." Particularly noteworthy is that ST was the only type to prefer "Exercises" and "Homework Assignments", both at the .0001 level of significance. SFs "most preferred" five learning MTDs and was the only cognitive style type to prefer "Observation." The NT type produced eleven "most preferred" learning MTDs and differed from the other three

TABLE 5
PRE-TEST "MOST PREFERRED" LEARNING MTDs FOR THE TOTAL SAMPLE
AND THE FOUR COGNITIVE STYLE TYPES

<u>Learning MTD</u>	<u>Total Sample (N=529)</u>	<u>ST (N=278)</u>	<u>SF (N=62)</u>	<u>NT (N=155)</u>	<u>NF (N=34)</u>
Demonstration	****	****	****	****	****
Group Discussion	****	****	****	****	****
Discuss w/Instructor	****	****	****	****	NA
Confer w/Other Students	****	****	**	**	NA
Exercises	****	****	NA	NA	NA
Case Study	****	***	NA	*	***
Guest Lecturer/Speaker	****	***	NA	*	*
Lecture	****	**	NA	*	*
Simulations	****	***	NA	*	NA
Laboratory	***	*	NA	**	NA
Reading	***	NA	NA	*	**
Homework Assignments	***	****	NA	NA	NA
Observation	**	NA	**	NA	NA
Group Projects	*	NA	NA	NA	NA
Independent Study	*	NA	NA	*	NA

Level of Significance

p < .05
p < .01
p < .001
p < .0001
Not Applicable/
Not Significant

Symbol

*
**

NA

types by showing a significant preference for "Independent Study." The NF type "most preferred" six learning MTDs and was the only type to not significantly "most prefer" the MTDs of "Discuss w/Instructor" and "Confer w/Other Students."

Table 6 shows all of the "least preferred" learning MTDs. Again, only levels of statistical significance are shown by the table and the complete values and calculation

TABLE 6
PRE-TEST "LEAST PREFERRED" LEARNING MTDs FOR THE TOTAL
SAMPLE AND FOUR COGNITIVE STYLE TYPES

<u>Learning MTD</u>	<u>Total Sample (N=529)</u>	<u>ST (N=278)</u>	<u>SF (N=62)</u>	<u>NT (N=155)</u>	<u>NF (N=34)</u>
Memorization	****	****	****	****	****
Pop Quiz	****	****	****	****	****
Drill and Repetition	****	****	**	****	**
Role Play	****	****	NA	***	****
Term Paper	****	****	*	***	NA
Oral Reports	****	****	*	NA	NA
Peer Teaching	****	****	*	NA	NA
Lecture	***	NA	**	NA	NA
Group Projects	**	*	NA	NA	NA
Debate	NA	*	***	NA	NA
Examination	NA	NA	*	NA	NA
Programmed Instruction	NA	NA	NA	*	NA

Level of Significance

p < .05

p < .01

p < .001

p < .0001

Not Applicable/

Not Significant

Symbol

*

**

NA

results are at Appendix D. "Memorization", "Pop Quiz", and "Drill and Repetition" were significant for the total sample and all cognitive style types, indicating that these learning MTDs are generally "least preferred" by all groups. The first two were at a .0001 level of significance, and the levels of significance for "Drill and Repetition" varied between .01 and .0001.

STs "least preferred" nine learning MTDs and was the only type to significantly "least prefer" the MTD of "Group Projects." SFs also "least preferred" nine MTDs and were

alone in significantly "least preferring" the MTDs of "Lecture" and "Examination." The NT cognitive style type "least preferred" six learning MTDs and was the only type to significantly "least prefer" "Programmed Instruction." The NFs "least preferred" four learning MTDs, all of which were also "least preferred" by at least two of the other cognitive style types.

"Group Projects" and "Lecture" are the only learning MTDs which appear as both "most preferred" and "least preferred" for the total sample. For the cognitive style types, no learning MTDs appear on both lists.

The third step in answering this investigative question was to compare the learning MTD preference distributions of the four cognitive style types to one another. The purpose of this step was to identify which cognitive style type learning MTD preference distributions are significantly different. Figure 11 shows the chi-squared analysis procedure and the test results. A total of twelve comparisons were performed, with each cognitive style type compared to all other types for both preference distributions. For each test, the type with the larger sample size provided the expected frequencies and the other type provided the observed counts. The null hypothesis states that the thirty-four learning MTD preferences for both cognitive style types are equal, while the alternative hypothesis is that at least one of the MTD preferences is significantly different.

Ho: $p_{1,1} = p_{2,1}, p_{1,2} = p_{2,2}, \dots, p_{1,34} = p_{2,34}$

... where $p_{1,i}$ is the probability that MTD i is preferred ("most" or "least") by the first cognitive style type and $p_{2,i}$ is the probability that MTD i is preferred by the second type.

Ha: At least one $p_{1,i}$ does not equal $p_{2,i}$

Test Statistic: $\chi^2 = \sum_{i=1}^{34} [n_i - E(n)_i]^2 / E(n)_i$

...where $n_i = p_{2,i}n$, the observed count of the members from the second cognitive style type who selected MTD i as preferred, and $E(n)_i = p_{1,i}n$, the expected count of the second type members who select MTD i based upon the first type's preference probability for MTD i . The total number of second type members multiplied by five (the number of "most preferred" and "least preferred" choices for each student) equals n .

Critical χ^2 Values for $df = 33$:

$\chi^2_{.05}$	>	47.40
$\chi^2_{.01}$	>	54.775
$\chi^2_{.001}$	>	63.86
$\chi^2_{.0001}$	>	71.87

χ^2 Test Statistic Values and Conclusions:

Types Compared	χ^2 "Most Preferred" TS Value	Concl	χ^2 "Least Preferred" TS Value	Concl
ST to SF	31.1966	*FTR Ho	36.9241	*FTR Ho
ST to NT	71.9640	Reject Ho	65.0446	Reject Ho
ST to NF	50.0591	Reject Ho	31.8264	*FTR Ho
SF to NF	87.6442	Reject Ho	58.3768	Reject Ho
NT to SF	42.8432	*FTR Ho	97.4182	Reject Ho
NT to NF	61.4754	Reject Ho	34.8361	*FTR Ho

* Fail to reject

Figure 11. Chi-Squared Analysis Comparing the Learning MTD Preference Distributions of the Cognitive Style Types

Of the twelve comparisons of cognitive style learning MTD preference distributions, seven showed statistically significant differences. The null hypothesis was rejected in four of the six "most preferred" distribution comparisons

and in three of the six "least preferred" distribution comparisons.

For the "most preferred" learning MTD distributions, ST to NT, ST to NF, SF to NF, and NT to NF are significantly different. Among the "least preferred" distributions, ST to NT, NT to SF, and SF to NF are different. It is noteworthy that the "most preferred" distributions of NT to SF and "least preferred" distributions of ST to NF, representing polar extremes along the two dichotomous scales, are not statistically different.

The fourth and final step in answering Investigative Question 3 was to analyze the specific learning MTDs for the cognitive style type preference distributions identified as statistically different in the third step. Table 7 summarizes the significant learning MTD differences for each of the four pairs of statistically different "most preferred" distributions, and Table 8 does the same for the three pairs of statistically different "least preferred" distributions.

STs preferred "Exercises" and "Homework Assignments" while NTs did not. Both types significantly preferred "Group Discussion", but the NTs showed a greater preference for this MTD than did the STs. STs preferred "Exercises" and the NFs did not, while the NFs showed a greater preference for "Reading" than did the STs and SFs. NFs also preferred "Case Study" more than the SFs did, while both the

TABLE 7
SIGNIFICANTLY DIFFERENT LEARNING MTDs AMONG PAIRS OF
STATISTICALLY DIFFERENT "MOST PREFERRED" DISTRIBUTIONS

1. ST to NT:

<u>MTD</u>	<u>ST MTD</u> <u>Relative</u> <u>Frequency</u>	<u>NT MTD</u> <u>Relative</u> <u>Frequency</u>	<u>Level of</u> <u>Significance</u>
Exercises	5.97	3.35	***
Homework Assignments	4.82	2.58	**
Group Discussion	7.19	9.16	*

2. ST to NF:

<u>MTD</u>	<u>ST MTD</u> <u>Relative</u> <u>Frequency</u>	<u>NF MTD</u> <u>Relative</u> <u>Frequency</u>	<u>Level of</u> <u>Significance</u>
Exercises	5.97	2.35	*
Reading	3.74	6.47	*

3. SF to NF:

<u>MTD</u>	<u>SF MTD</u> <u>Relative</u> <u>Frequency</u>	<u>NF MTD</u> <u>Relative</u> <u>Frequency</u>	<u>Level of</u> <u>Significance</u>
Reading	2.90	6.47	**
Case Study	4.19	7.06	*
Discuss w/Instructor	7.42	4.12	*

4. NT to NF:

<u>MTD</u>	<u>NT MTD</u> <u>Relative</u> <u>Frequency</u>	<u>NF MTD</u> <u>Relative</u> <u>Frequency</u>	<u>Level of</u> <u>Significance</u>
Discuss w/Instructor	7.87	4.12	*

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****

SFs and NTs showed a significantly stronger preference for "Discuss w/Instructor" than did the NFs.

STs "least preferred" the MTDs of "Debate" and "Oral Reports" at a greater rate than did the NTs, and the NTs "least preferred" "Programmed Instruction" more than the STs

TABLE 8
SIGNIFICANTLY DIFFERENT LEARNING MTDs AMONG PAIRS OF
STATISTICALLY DIFFERENT "LEAST PREFERRED" DISTRIBUTIONS

1. ST to NT:

<u>MTD</u>	<u>ST MTD Relative Frequency</u>	<u>NT MTD Relative Frequency</u>	<u>Level of Significance</u>
Debate	3.96	1.29	****
Drill and Repetition	5.40	7.74	***
Programmed Instruction	2.59	4.13	**
Oral Reports	5.54	3.74	*
Memorization	9.14	10.71	*

2. NT to SF:

<u>MTD</u>	<u>NT MTD Relative Frequency</u>	<u>SF MTD Relative Frequency</u>	<u>Level of Significance</u>
Debate	1.29	6.13	****
Role Play	5.03	2.26	*

3. SF to NF:

<u>MTD</u>	<u>SF MTD Relative Frequency</u>	<u>NF MTD Relative Frequency</u>	<u>Level of Significance</u>
Role Play	2.26	8.24	****
Oral Reports	4.84	1.18	*

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****

did. Both types significantly "least preferred" the learning MTDs of "Drill and Repetition" and "Memorization", but the NTs showed statistically stronger "least" preferences than did the STs. Both the NTs and NFs "least preferred" the learning MTD of "Role Play" more than the SFs did. The SFs "least preferred" "Debate" more than the NTs did and "Oral Reports" more than the NFs did.

Appendix E shows the complete calculations and results for the analyses of all pairs of distributions and all learning MTDs.

Investigative Question 4

Do cognitive style types change during the period of time between the pre-test and post-test MBTI?

A chi-squared goodness of fit test was calculated to compare the sample post-test MBTI cognitive style type frequency distribution to that of the pre-test. Figure 12 shows the analysis procedures and test results. As Figure 12 shows, the post-test distribution differs from the pre-test at greater than the .01 level of significance. Therefore, one can conclude that the composition of cognitive style types does not remain the same during the period of time from the pre-test to the post-test MBTI. Table 9 shows the pre-test to post-test distribution changes by cognitive style type. Cognitive style types SF and NF produced the greatest changes, while the distribution of STs and NTs changed very little. SF dropped from a pre-test relative frequency of 11.72 percent to a post-test frequency of 8.13 percent, while NF increased from 6.43 percent to 9.45 percent.

Investigative Question 5

Do preferences for learning MTDs change during the period of time between the pre-test and post-test LSS?

$H_0: p_{0,1} = p_{1,1}, p_{0,2} = p_{1,2}, p_{0,3} = p_{1,3}, \text{ and } p_{0,4} = p_{1,4}$

...where $p_{0,i}$ = the post-test frequency and $p_{1,i}$ = the pre-test frequency for MBTI cognitive style type i .

H_a : At least one $p_{0,i}$ does not equal $p_{1,i}$

Test Statistic: $\chi^2 = \sum_{i=1}^4 [n_i - E(n)_i]^2 / E(n)_i$

...where $n_i = p_{0,i}n$, the number of students testing into MBTI cognitive style type i from the post-test, and $E(n)_i = p_{1,i}n$, the expected number of students testing into MBTI cognitive style type i from the post-test based upon the pre-test frequency for that type. The total number of sample members equals n .

Critical χ^2 Values for $df = 3$:

$\chi^2_{.05}$	>	7.81473
$\chi^2_{.01}$	>	11.345
$\chi^2_{.001}$	>	16.275
$\chi^2_{.0001}$	>	21.01

Test Statistic Value: $\chi^2 = 13.8756$

Conclusion: Reject H_0 at the .01 level of significance.

Figure 12. Chi-Squared Analysis Comparing the Post-Test Sample Distribution of MBTI Cognitive Style Types to that of the Pre-Test

TABLE 9
PRE-TEST TO POST-TEST COGNITIVE STYLE TYPE DISTRIBUTION
COMPARISON

MBTI Type	Pre-Test Number/ Relative Frequency	Post-Test Number/ Relative Frequency	Chi-Squared Test Statistic Value
ST	278/52.55%	287/54.25%	0.2913
SF	62/11.72%	43/ 8.13%	5.8226
NT	155/29.30%	149/28.17%	0.2323
NF	34/ 6.43%	50/ 9.45%	7.5294
Totals	529/100.00%	529/100.00%	13.8756

This question was also answered using a chi-squared goodness of fit test. Both post-test learning MTD preference distributions ("most preferred" and "least preferred") were compared to their pre-test counterparts. Figure 13 shows the analysis procedures and test results. Both post-test distributions differ from those of the pre-test at the .0001 level of significance.

Ho: $p_{0,1} = p_{1,1}, p_{0,2} = p_{1,2}, \dots$, and $p_{0,34} = p_{1,34}$

...where $p_{0,i}$ = the sample post-test frequency and $p_{1,i}$ = the sample pre-test frequency for MTD i.

Ha: At least one $p_{0,i}$ does not equal $p_{1,i}$

Test Statistic:
$$\chi^2 = \sum_{i=1}^{34} [n_i - E(n)_i]^2 / E(n)_i$$

...where $n_i = p_{0,i}n$, the number of times MTD i was selected as preferred ("most" or "least") from the post-test LSS results, and $E(n)_i = p_{1,i}n$, the expected number of times MTD i would be selected as preferred from the post-test LSS results based upon the pre-test frequency. The total number of sample members multiplied by five (the number of possible "most preferred" and "least preferred" choices for each student) equals n.

Critical χ^2 Values for df = 33:

$\chi^2_{.05}$	>	47.4
$\chi^2_{.01}$	>	54.775
$\chi^2_{.001}$	>	63.86
$\chi^2_{.0001}$	>	71.87

Test Statistic Values:

"Most Preferred" Distribution: $\chi^2 = 488.6065$

"Least Preferred" Distribution: $\chi^2 = 496.9266$

Conclusions: Reject Ho for both distributions at the .0001 level of significance.

Figure 13. Chi-Squared Analysis Comparing the Sample Post-Test Learning MTD Preference Distributions to Those of the Pre-Test

For the "most preferred" distribution, twelve MTD preference frequencies changed significantly, while there were seven significant changes in the "least preferred" distribution. Table 10 summarizes these changes.

The post-test relative frequencies for the "most preferred" learning MTDs of "Confer w/Other Students", "Case Study", "Group Projects", "Group Discussion", "Homework Assignments", "Independent Study", and "Lecture" significantly increased over the pre-test numbers, while the relative frequencies for "Demonstration", "Observation", "Exercises", "Laboratory", and "Simulations" decreased. For the "least preferred" learning MTDs, the post-test relative frequencies for "Examination", "Case Study", "Term Paper", "Group Projects", and "Memorization" rose from the pre-test levels, and those for "Role Play" and "Pop Quiz" dropped. It is noteworthy that the relative frequencies for "Case Study" and "Group Projects" increased significantly under both preference distributions ("most" and "least").

Appendix G shows the complete calculations and results for the analyses of the post-test to pre-test total sample distributions and learning MTDs.

Investigative Question 6

If there were significant relationships between cognitive style types and preferences for learning MTDs, as measured by the pre-test MBTI and LSS, have these

TABLE 10
SUMMARY OF SIGNIFICANT LEARNING MTD DIFFERENCES FROM THE
POST-TEST TOTAL SAMPLE PREFERENCE DISTRIBUTIONS COMPARED TO
THOSE OF THE PRE-TEST

<u>MTD</u>	<u>Post-Test Relative Frequency</u>	<u>Pre-Test Relative Frequency</u>	<u>Level of Significance</u>
<u>"Most Preferred":</u>			
Confer w/Other Students	8.24	4.84	****
Demonstration	5.29	9.57	****
Case Study	7.26	4.57	****
Group Projects	5.75	3.63	****
Observation	1.85	3.86	****
Group Discussion	10.25	7.75	****
Exercises	2.80	4.73	****
Laboratory	2.04	4.01	****
Homework Assignments	5.14	3.97	***
Independent Study	4.54	3.63	**
Simulations	3.25	4.23	**
Lecture	5.14	4.23	**

"Least Preferred":

Examination	7.86	3.48	****
Case Study	3.97	1.66	****
Role Play	2.61	4.99	****
Term Paper	6.54	4.76	****
Pop Quiz	6.54	8.54	****
Group Projects	4.91	3.82	***
Memorization	10.47	9.45	**

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****

*relationships changed significantly when compared to the
post-test MBTI and LSS measurements?*

Table 11 shows the "most preferred" learning MTDs for
the total sample and four cognitive style types as

TABLE 11
POST-TEST "MOST PREFERRED" LEARNING MTDs FOR THE TOTAL
SAMPLE AND THE FOUR COGNITIVE STYLE TYPES

<u>Learning MTD</u>	<u>Total Sample (N=529)</u>	<u>ST (N=287)</u>	<u>SF (N=43)</u>	<u>NT (N=149)</u>	<u>NF (N=50)</u>
Group Discussion	****	****	****	****	****
Confer w/Other Students	****	****	****	****	****
Case Study	****	****	*	****	****
Discuss w/Instructor	****	****	****	****	**
Group Projects	****	****	***	****	****
Lecture	****	****	***	*	*
Demonstration	****	****	NA	**	NA
Homework Assignments	****	****	NA	****	NA
Independent Study	****	*	NA	****	***
Guest Lecturer/ Speaker	***	***	NA	*	NA
Reading	*	NA	NA	NA	NA
Exercises	NA	NA	NA	NA	*

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable/ Not Significant	NA

identified by the post-test MBTI and LSS, and Table 12 shows the same for the "least preferred" distributions. These tables only show the statistical levels of significance. All values and calculation results are at Appendix F. The post-test distributions were analyzed for the existence of preferences and the learning MTDs were isolated using the same chi-squared analysis procedures as were used for the pre-test distributions (see Figures 9 and 10). The complete

chi-squared analysis calculations and results are also at Appendix F.

Six learning MTDs ("Group Discussion", "Confer w/Other Students", "Case Study", "Discuss w/Instructor", "Group Projects", and "Lecture") are "most preferred" and three ("Examination", "Memorization", and "Pop Quiz") are "least preferred" by all cognitive style types. Although it was significantly "most preferred" by all cognitive style types under the pre-test distributions, "Demonstration" is "most preferred" by two of the four types for the post-test. "Drill and Repetition" also changed from an MTD which was "least preferred" by all types under the pre-test to one which is significant in three of the four types under the post-test distributions.

As in the pre-test distributions, "Group Projects" and "Lecture" again appear as both "most preferred" and "least preferred" for the total sample. Unlike the pre-test distributions, however, these two learning MTDs also appear on both preference lists for ST, and "Lecture" appears as "most preferred" and "least preferred" for NT and NF. "Case Study" also appears on both the post-test "most preferred" and "least preferred" MTDs lists for the total sample, SFs, and NTs.

Using the same chi-squared analysis procedures as were used to answer Investigative Question 5 (see Figure 13), each of the eight post-test cognitive style sample learning MTD preference distributions were compared to their pre-test

TABLE 12
POST-TEST "LEAST PREFERRED" LEARNING MTDs FOR THE TOTAL
SAMPLE AND THE FOUR COGNITIVE STYLE TYPES

<u>Learning MTD</u>	<u>Total Sample (N=529)</u>	<u>ST (N=287)</u>	<u>SF (N=43)</u>	<u>NT (N=149)</u>	<u>NF (N=50)</u>
Examination	****	****	****	****	****
Memorization	****	****	****	****	****
Pop Quiz	****	****	***	****	***
Term Paper	****	****	****	***	NA
Drill and Repetition	****	****	NA	****	****
Group Projects	****	****	NA	****	*
Peer Teaching	****	****	NA	NA	NA
Lecture	****	*	NA	**	**
Case Study	***	NA	*	**	NA
Oral Reports	***	**	*	NA	NA

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable/ Not Significant	NA

counterparts to determine whether or not they had significantly changed. Seven of the eight comparisons showed differences at the .0001 level of significance, and the remaining comparison showed a difference at the .001 level of significance, indicating that both post-test preference distributions ("most" and "least") for all cognitive style types changed significantly from the pre-test. The complete analysis calculations and results are shown at Appendix G.

Table 13 summarizes the specific "most preferred" learning MTDs which changed significantly from the pre-test

to the post test by cognitive style type, and Table 14 shows the same for the "least preferred" MTDs.

There are several noteworthy general changes in learning MTD preferences from the post-test distributions compared to those of the pre-test. The post-test "most preferred" relative frequencies for "Confer w/Other Students" increased over the pre-test frequencies for all cognitive style types. The relative frequencies for "Group Projects" increased for three of the four types (ST, NT, and NF), while those for "Demonstration" dropped for all four of the types. For the "least preferred" MTD distributions, the post-test relative frequencies for "Examination" increased over the pre-test frequencies for all types, and the "Case Study" relative frequencies increased for three of the four types (ST, SF, and NT). The post-test relative frequencies for "Role Play" and "Pop Quiz" dropped for three types (ST, NT, and NF).

For the ST cognitive style type, the learning MTD of "Group Projects" is not significantly "most preferred" under the pre-test distribution, but it is for the post-test; while "Exercises" and "Laboratory" are significant from the pre-test results but are not for the post-test. For the "least preferred" distribution, "Examination" and "Case Study" are added to the post-test list, and "Role Play" and "Debate" are dropped.

The SF post-test "most preferred" learning MTD distribution significant differences from the pre-test

TABLE 13
SUMMARY OF SIGNIFICANT LEARNING MTD DIFFERENCES FROM THE
POST-TEST "MOST PREFERRED" DISTRIBUTION COMPARED TO THAT OF
THE PRE-TEST BY COGNITIVE STYLE TYPE

<u>MTD</u>	<u>Post-Test Relative Frequency</u>	<u>Pre-Test Relative Frequency</u>	<u>Level of Significance</u>
ST:			
Confer w/Other Students	7.80	4.68	****
Exercises	2.58	5.97	****
Group Discussion	10.73	7.19	****
Demonstration	5.85	9.57	****
Case Study	6.69	4.46	****
Laboratory	2.02	3.96	****
Lecture	5.44	4.10	**
Group Projects	4.81	3.60	**
SF:			
Confer w/Other Students	11.63	5.81	****
Demonstration	4.65	10.00	***
Observation	2.33	5.81	*
Lecture	6.51	3.87	*
Group Discussion	9.77	6.45	*
NT:			
Homework Assignments	5.77	2.58	****
Case Study	8.05	4.39	****
Group Projects	6.58	3.48	****
Demonstration	4.83	9.94	****
Confer w/Other Students	7.92	4.77	****
Laboratory	1.61	4.77	****
NF:			
Group Projects	7.60	2.94	****
Confer w/Other Students	8.80	4.71	***
Exercises	5.20	2.35	**
Case Study	10.00	7.06	*
Demonstration	4.00	7.06	*
Guest Lecturer/Speaker	3.20	5.88	*

Levels of Significance

Symbol

p < .05

*

p < .01

**

p < .001

p < .0001

TABLE 14
SUMMARY OF SIGNIFICANT LEARNING MTD DIFFERENCES FROM THE
POST-TEST "LEAST PREFERRED" DISTRIBUTION COMPARED TO THAT OF
THE PRE-TEST BY COGNITIVE STYLE TYPE

<u>MTD</u>	<u>Post-Test Relative Frequency</u>	<u>Pre-Test Relative Frequency</u>	<u>Level of Significance</u>
ST:			
Examination	7.25	3.09	****
Term Paper	7.53	4.68	****
Case Study	3.69	1.94	****
Role Play	2.51	5.18	****
Debate	1.88	3.96	****
Group Projects	5.71	3.96	***
Pop Quiz	6.34	8.20	**
Oral Reports	4.18	5.54	*
Memorization	10.45	9.14	*
SF:			
Case Study	5.12	1.94	***
Term Paper	9.30	4.84	***
Examination	8.37	4.84	**
Debate	2.33	6.13	**
NT:			
Case Study	4.56	1.16	****
Examination	7.92	3.48	****
Role Play	3.36	5.03	*
Pop Quiz	6.85	8.77	*
NF:			
Examination	10.80	4.12	****
Role Play	1.20	8.24	****
Memorization	11.20	8.24	*
Pop Quiz	6.40	10.00	*
<u>Levels of Significance</u>		<u>Symbol</u>	
p < .05		*	
p < .01		**	
p < .001		***	
p < .0001		****	

counterpart include the addition of "Lecture" and the deletion of "Observation." Also, "Debate" is dropped from the "least preferred" MTD list and "Case Study" is added.

Significant changes from the pre-test "most preferred" distribution to that of the post-test for the NTs are "Homework Assignments" and "Group Projects" are added and "Laboratory" is deleted. "Case Study" and "Examination" are significant "least preferred" learning MTDs for the post-test but not for the pre-test. Also, "Role Play", although included as a "least preferred" MTD for the pre-test, is not significant under the post-test results.

For the NF cognitive style type, "Group Projects", "Confer w/Other Students", and "Exercises" are all significant "most preferred" learning MTDs for the post-test but are not for the pre-test. "Guest Lecturer/Speaker" is "most preferred" under the pre-test but is not significant for the post-test. For the "least preferred" distributions, "Examination" is added to the post-test list and "Role Play" is dropped.

Summary

This chapter presented the results of the data analyses for the demographic information and the investigative questions. The next chapter will discuss these results and render conclusions regarding the research and investigative questions.

V. Conclusions

This chapter presents the conclusions based on the data results and analyses from the previous chapter. The conclusions are discussed in order by investigative question and are followed by the resolution of the research question.

Investigative Question 1

What is the reliability and validity of the MBTI and LSS?

This investigative question was necessary because, unless both survey instruments demonstrate adequate reliability and validity, no research conclusions can be drawn based on the data collected by them. Applying a conservative approach, the null hypothesis states that the MBTI and LSS do not demonstrate reliability and validity. Each instrument was tested for these two qualities using different sets of procedures, which are described in Chapter IV. The null hypothesis was rejected in favor of the alternative hypothesis, postulating that the MBTI and LSS do demonstrate reliability and validity. Therefore, the MBTI and LSS were accepted for use in this research.

A review of the existing literature revealed that the MBTI is well-supported in terms of internal reliability and stability, as well as content, construct, and predictive validity.

A test-retest reliability experiment on the LSS was completed as part of this research. The result was a test-retest reliability measurement of 58.84 percent. This figure would be considered low for a survey instrument designed to measure a more stable construct; however, according to Curry's model, instructional and learning preferences are the most dynamic of the four learning style components and the test-retest measurement for the LSS is, therefore, judged as sufficient. Content validity was built-in to the LSS during its initial design and revisions. Both the scope of the thirty-four learning MTDs and the description of each MTD were considered.

In summary, both survey instruments demonstrate sufficient reliability and validity, so it is possible to draw research conclusions based on the data collected by them.

Investigative Question 2

Is the distribution of cognitive style types, as measured by the pre-test MBTI, different from that of the general population?

The purpose of this investigative question was to determine whether the research findings are applicable only to the AFIT graduate school environment, or whether they may also be generalized to other adult educational settings. The question's null hypothesis states that the research population has the same distribution of cognitive style

types as the general population, as estimated by the SRI International Values and Lifestyles (VALS) program. The sample type distributions, overall and stratified by gender, were first calculated and then compared to the SRI estimates (see Chapter IV, Figure 8). The null hypothesis was rejected and the alternative hypothesis, stating that the research population does not have the same distribution of cognitive style types as the general population, was accepted.

As shown at Appendix B, the total sample proportion of Sensing-Thinking cognitive style types is nearly equal to the SRI estimate. However, Sensing-Feeling and Intuitive-Feeling types are under-represented, while Intuitive-Thinking types are over-represented in the research sample. This same pattern holds true for the sample males, but the sample female distribution differs by also showing an over-representation of STs.

The results of the statistical tests and analyses for this investigative question clearly indicate that the population of AFIT School of Systems and Logistics graduate school students is significantly different from the general population. One can, therefore, conclude that the research population is unique and, thus, the research findings may have limited application beyond the AFIT environment.

Investigative Question 3

As measured by the pre-test MBTI and LSS, what are the relationships of the cognitive style types to preferences for learning MTDs?

The objective of this investigative question is to determine what, if any, relationships exist between student cognitive style types and their learning preferences prior to the beginning of the graduate school educational process; and, as specified in Chapter I, it is pivotal because its answer is essential to answering the research question. The null hypothesis states that cognitive style types are not significantly related to preferences for learning MTDs, as measured by the pre-test MBTI and LSS, while the alternative hypothesis states that relationships do exist. The question was answered in four steps, as described in Chapter IV, with a different chi-squared analysis procedure used for each step. The results from the pre-test statistical tests and analyses clearly show that cognitive style types are significantly related to learning preferences, and the null hypothesis is rejected and the alternative hypothesis accepted.

Five learning MTDs are not specifically related to cognitive style type and are instead significantly preferred ("most" and "least") by all types. Two of these MTDs are "most preferred" ("Demonstration" and "Group Discussion") and the other three are "least preferred" ("Memorization", "Pop Quiz", and "Drill and Repetition"). Two other pre-test

learning MTDs ("Group Projects" and "Lecture") are both significantly "most preferred" and "least preferred" by the overall population but not by any of the four cognitive style types.

The Sensing-Thinking type is the only one to "most prefer" the learning MTDs "Exercises" and "Homework Assignments" and to "least prefer" "Group Projects." This cognitive style type also "most prefers" "Discuss w/Instructor", "Confer w/Other Students", "Case Study", "Guest Lecturer/Speaker", "Lecture", "Simulations", and "Laboratory." In addition to "Group Projects", STs show significant pre-test "least" preferences for the MTDs of "Role Play", "Term Paper", "Oral Reports", Peer Teaching", and "Debate."

Like the ST type, the Sensing-Feeling cognitive style type "most prefers" "Discuss w/Instructor" and "Confer w/Other Students" and "least prefers" "Term Paper", "Oral Reports", Peer Teaching", and "Debate." Also, SFs are the only pre-test type to significantly "most prefer" "Observation" and "least prefer" "Lecture" and "Examination".

The Intuitive-Thinking type shared significant pre-test "most" preferences with STs for the learning MTDs of "Discuss w/Instructor", "Confer w/Other Students", "Case Study", "Guest Lecturer/Speaker", "Lecture", "Simulations", and "Laboratory" and "least" preferences for "Role Play" and "Term Paper." Along with the Intuitive-Feeling type,

NTs also "most prefer" "Reading." And the NT type is the only one to "most prefer" "Independent Study" and "least prefer" "Programmed Instruction."

Like STs and NTs, the pre-test Intuitive-Feeling cognitive style type "most prefers" "Case Study", "Guest Lecturer/Speaker", and "Lecture" and "least prefers" "Role Play." It also shares a significant "most" preference for "Reading" with NTs. There are no pre-test learning MTDs which are "most preferred" or "least preferred" by only the NF type; however, NFs are the only type to not show a significant "most" preference for "Discuss w/Instructor" and "Confer w/Other Students" and a "least" preference for "Term Paper."

All pre-test cognitive style type "most preferred" learning MTD distributions were compared to one another, as were all cognitive style type "least preferred" MTD distributions, to determine which are statistically different. The NF type is statistically different from all other types for the "most preferred" learning MTD distribution and from SFs for the "least preferred" distribution. STs are also different from NTs for "most preferred" and "least preferred" MTD distributions. And the NT "most preferred" distribution is statistically different from that of NFs, and its "least preferred" learning MTD distribution is different from the SF distribution. The only two cognitive style types which are not statistically

different from one another for at least one of the two kinds of learning MTD preference distributions are ST and SF.

Tables 5 and 6 in Chapter IV summarize the pre-test learning MTDs for which the cognitive style types significantly differ in their preferences ("most" and "least"). STs significantly "most prefer" "Homework Assignments" and "Exercises", while the NTs and NFs ("Exercises" only) do not. Both the STs and NTs prefer "Group Discussion", but the NTs show a stronger preference for this MTD than do the STs. The NFs "most prefer" "Reading", while the STs and SFs do not. The NFs also prefer "Case Study" more than the SFs do, while both the NTs and SFs show a significantly stronger preference for "Discuss w/Instructor" than do the NFs. STs "least prefer" the MTDs of "Debate" and "Oral Reports" more than the NTs, and the NTs "least prefer" "Programmed Instruction" while the STs do not. Both the NTs and NFs "least prefer" "Role Play" more than the SFs do. The SFs "least prefer" "Debate" more than the NTs and "Oral Reports" more than the NFs.

In summary, relationships do exist between student cognitive style types and their learning preferences prior to the beginning of the AFIT graduate school educational process, with the one exception that ST learning preferences are not statistically different from those of SFs. More specifically, there are five learning MTDs which are not related to cognitive style type but are significantly preferred ("most" or "least") by all types. All other MTD

preferences vary by type, but several are significantly preferred by two or three of the four types. Also, the relative strengths of the individual learning MTD preferences often differ among the cognitive style types.

Investigative Question 4

Do cognitive style types change during the period of time between the pre-test and post-test MBTI?

This investigative question was included in this research to determine the stability of the composition of population cognitive style types. It was not designed as a test-retest reliability experiment on the MBTI. The analysis procedures addressed only the overall composition of sample cognitive style types and did not consider bipolar scale strength scores nor the other two MBTI dichotomous scales.

The question's null hypothesis states that the post-test distribution of MBTI cognitive style types equals that of the pre-test. Both distributions were first calculated and then compared using a standard chi-squared goodness of fit test, with the pre-test proportions representing the expected values and the post-test proportions representing the observed values (see Chapter IV, Figure 12). The null hypothesis was rejected and the alternative hypothesis, stating that the pre-test and post-test distributions are not equal, was accepted.

More specifically, the proportions for the Sensing-Thinking and Intuitive-Thinking cognitive style types did not change significantly. The greatest changes occurred for the other two types. Sensing-Feeling dropped from a pre-test proportion of 11.72 percent to 8.13 percent on the post-test. The Intuitive-Feeling type increased from 6.43 percent on the pre-test to a 9.45 percent post-test proportion.

In summary, the distribution of student cognitive style types does not remain the same during the period of time between the pre-test and post-test MBTI. The proportions of ST and NT types remain stable, while the proportions of SFs decrease and NFs increase.

Investigative Question 5

Do preferences for learning MTDs change during the period of time between the pre-test and post-test LSS?

The purpose of this investigative question was to determine how stable or dynamic student preferences for learning MTDs are. The null hypothesis states that the pre-test and post-test distributions of learning MTD preferences are equal, against the alternative hypothesis which postulates that they are not equal. Both learning MTD preference distributions ("most preferred" and "least preferred") were first calculated for the pre-test and post-test. Then, using a standard chi-squared goodness of fit test, each pre-test distribution was compared to its post-

test counterpart, with the pre-test relative frequencies representing the expected values and the post-test frequencies representing the observed values (see Chapter IV, Figure 13). For both types of learning MTD preference distributions, the null hypothesis was rejected and the alternative hypothesis accepted.

A second chi-squared analysis procedure was used to identify the specific learning MTDs which showed significant differences between the pre-test and post-test LSS. Student preferences for seventeen learning MTDs significantly changed (see Chapter IV, Table 9). In terms of the "most preferred" learning MTDs, post-test preferences for "Confer w/Other Students", "Case Study", "Group Projects", "Group Discussion", "Homework Assignments", "Independent Study", and "Lecture" all increased over their pre-test levels, and preferences for "Demonstration", "Observation", "Exercises", "Laboratory", and "Simulations" decreased. The post-test "least preferred" learning MTDs of "Examination", "Case Study", "Term Paper", "Group Projects", and "Memorization" significantly rose from their pre-test numbers, while "Role play" and "Pop Quiz" dropped. Preferences for "Group Projects" and "Case Study" increased from the pre-test LSS to the post-test for both types of preference distributions ("most" and "least"), indicating that the mixed reactions elicited by these two MTDs from the research population strengthened.

In summary, student preferences for learning MTDs change significantly for both the "most preferred" and "least preferred" type preference distributions during the period of time between the pre-test and post-test LSS.

Investigative Question 6

If there were significant relationships between cognitive style types and preferences for learning MTDs, as measured by the pre-test MBTI and LSS, have these relationships changed significantly, as compared to the post-test MBTI and LSS measurements?

This investigative question's purpose was to determine how stable or dynamic the relationships between cognitive style types and learning preferences are over the course of the graduate school educational process. Like Investigative Question 3, its answer is essential to answering the research question. The question's null hypothesis states that relationships between cognitive style types and preferences for learning MTDs do not change significantly during the time between the pre-test and post-test MBTI and LSS, and the alternative hypothesis states that the relationships do change. First, all of the post-test cognitive style type learning MTD preference distributions were calculated and then each was compared to its pre-test counterpart using a standard chi-squared goodness of fit test. For each distribution, the pre-test relative frequencies represented the expected values and the post-

test frequencies were the observed values. The null hypothesis was rejected for all comparisons and the alternative hypothesis accepted.

Tables 10 and 11 in Chapter IV show the significant post-test "most preferred" and "least preferred" learning MTDs for the total sample and four cognitive style types. While the pre-test results show two learning MTDs which are significantly "most preferred" by all cognitive style types ("Demonstration" and "Group Discussion"), there are six such MTDs from the post-test distributions ("Group Discussion", "Confer w/Other Students", "Case Study", "Discuss w/Instructor", "Group Projects", and "Lecture"). "Demonstration" is significant for only two of the four post-test cognitive style types (ST and NT), instead of all four types as it is under the pre-test distributions. The significant post-test "least preferred" learning MTDs for all cognitive style types are "Examination", "Memorization", and "Pop Quiz." "Memorization" and "Pop Quiz" are also "least preferred" by all types for the pre-test, but "Examination" is significant for only one of the pre-test cognitive style types (SF). "Drill and Repetition" changed from an MTD which is "least preferred" by all pre-test types to one which is significant for three of the four types under the post-test (ST, NT, and NF). Unlike the pre-test, the post-test results show three learning MTDs which elicit mixed reactions from cognitive style type members. "Group Projects" (ST), "Lecture" (ST, NT, and NF), and "Case Study"

(SF and NT) appear as both "most preferred" and "least preferred" for at least one of the cognitive style types.

Another chi-squared analysis procedure was applied to identify how each cognitive style type learning MTD preference distribution changed from the pre-test to the post-test in terms of specific learning MTDs. Tables 12 and 13 in Chapter IV summarize the results of the analyses.

Generally, the post-test "most" preference for "Confer w/Other Students" and "least" preference for "Examination" significantly increased over the pre-test levels for all cognitive style types; while the "most preferred" levels for "Demonstration" decreased for all types.

Other post-test "most preferred" learning MTDs which show significant increases over their pre-test levels include "Group Discussion" (ST and SF), "Case Study" (ST, NT and NF), "Lecture" (ST and SF), "Group Projects" (ST and NT), "Homework Assignments" (NT), and "Exercises" (NF). The additional MTDs which significantly dropped from their pre-test "most preferred" numbers are "Exercises" (ST), "Laboratory" (ST and NT), "Observation" (SF), and "Guest Lecturer/Speaker" (NF).

Other than "Examination", the post-test "least preferred" learning MTDs which increased significantly from the pre-test are "Term Paper" (ST and SF), "Case Study" (ST, SF, and NT), "Group Projects" (ST), and "Memorization" (ST and NF). Those MTDs which dropped significantly from the pre-test include "Role Play" (ST, NT, and NF), "Debate" (ST

and SF), "Pop Quiz" (ST, NT, and NF), and "Oral Reports" (ST).

In summary, the pre-test relationships between cognitive style types and learning preferences do change significantly during the graduate school program. These changes take the form of additions to and deletions from the lists of significantly "most preferred" and "least preferred" learning MTDs, as well as changes to the relative strengths of the individual learning MTD preferences.

Research Question

What are the relationships between the cognitive style types of students and their preferences for learning MTDs, as measured by the pre-test and post-test MBTI and LSS?

The statistical test and analysis results from Investigative Questions 3 and 6 provide conclusive evidence that relationships between AFIT student cognitive style types and learning preferences do exist. Furthermore, these relationships change significantly during the period of time the students attend AFIT; however, the statistical analyses are not sufficient to support the conclusion that the graduate school educational process causes the changes in the relationships.

Using a format similar to Lawrence's portrayal of Morgan's theory linking MBTI psychological types to learning preferences (see Chapter II, Figure 5), Figure 14 summarizes the pre-test relationships between cognitive style and

learning preferences, and Figure 15 does the same for the post-test relationships.

The learning MTDs common to all cognitive style types are included in Figures 14 and 15 for ease of reference, but it is important to note that they are not related to cognitive style type. These learning MTDs are marked with an "*". They include the "most preferred" MTDs of "Demonstration" and "Group Discussion" for the pre-test, and "Group Discussion", "Confer w/Other Students", "Case Study", "Discuss w/Instructor", "Group Projects", and "Lecture" for the post-test; and the "least preferred" learning MTDs of "Drill and Repetition" (pre-test only), "Memorization", "Pop Quiz", and "Examination" (post-test only).

Summary

This chapter discussed the investigative and research question conclusions. The next chapter presents recommendations based upon these conclusions.

Sensing-Thinking <u>"Most Prefers:"</u> - *Demonstration - *Group Discussion - Discuss w/Instructor - Confer w/Other Students - Exercises - Case Study - Guest Lecturer/Speaker - Lecture - Simulations - Laboratory - Homework Assignments <u>"Least Prefers:"</u> - *Memorization - *Pop Quiz - *Drill and Repetition - Role Play - Term Paper - Oral Reports - Peer Teaching - Group Projects - Debate	Intuitive-Thinking <u>"Most Prefers:"</u> - *Demonstration - *Group Discussion - Discuss w/Instructor - Confer w/Other Students - Case Study - Guest Lecturer/Speaker - Lecture - Simulations - Laboratory - Reading - Independent Study <u>"Least Prefers:"</u> - *Memorization - *Pop Quiz - *Drill and Repetition - Role Play - Term Paper - Programmed Instruction
Sensing-Feeling <u>"Most Prefers:"</u> - *Demonstration - *Group Discussion - Discuss w/Instructor - Confer w/Other Students - Observation <u>"Least Prefers:"</u> - *Memorization - *Pop Quiz - *Drill and Repetition - Term Paper - Oral Reports - Peer Teaching - Lecture - Debate - Examination	Intuitive-Feeling <u>"Most Prefers:"</u> - *Demonstration - *Group Discussion - Case Study - Guest Lecturer/Speaker - Lecture - Reading <u>"Least Prefers:"</u> - *Memorization - *Pop Quiz - *Drill and Repetition - Role Play

* Learning MTDs which are preferred by all types.

Figure 14. Pre-Test Relationships Between Cognitive Style Types and Preferences for Learning MTDs

Sensing-Thinking <u>"Most Prefers:"</u> - *Group Discussion - *Confer w/Other Students - *Case Study - *Discuss w/Instructor - *Group Projects - *Lecture - Demonstration - Homework Assignments - Independent Study - Guest Lecturer/Speaker <u>"Least Prefers:"</u> - *Examination - *Memorization - *Pop Quiz - Drill and Repetition - Term Paper - Group Projects - Peer Teaching - Lecture - Oral Reports	Intuitive-Thinking <u>"Most Prefers:"</u> - *Group Discussion - *Confer w/Other Students - *Case Study - *Discuss w/Instructor - *Group Projects - *Lecture - Demonstration - Homework Assignments - Independent Study - Guest Lecturer/Speaker <u>"Least Prefers:"</u> - *Examination - *Memorization - *Pop Quiz - Drill and Repetition - Term Paper - Group Projects - Lecture - Case Study
Sensing-Feeling <u>"Most Prefers:"</u> - *Group Discussion - *Confer w/Other Students - *Case Study - *Discuss w/Instructor - *Group Projects - *Lecture <u>"Least Prefers:"</u> - *Examination - *Memorization - *Pop Quiz - Term Paper - Oral Reports - Case Study	Intuitive-Feeling <u>"Most Prefers:"</u> - *Group Discussion - *Confer w/Other Students - *Case Study - *Discuss w/Instructor - *Group Projects - *Lecture - Independent Study - Exercises <u>"Least Prefers:"</u> - *Examination - *Memorization - *Pop Quiz - Drill and Repetition - Group Projects - Lecture

* Learning MTDs which are preferred by all types.

Figure 15. Post-Test Relationships Between Cognitive Style Types and Preferences for Learning MTDs

VI. Recommendations

The purpose of this research was to determine the relationships between cognitive style types, as measured by the Myers-Briggs Type Indicator (MBTI), and learning preferences, as measured by the Learning Style Survey (LSS). This chapter presents recommendations for the use of the information gathered, as well as recommendations for future research. Because it was concluded that the research population of Air Force Institute of Technology School of Systems and Logistics graduate school students is unique, the specific recommendations based upon the research conclusions are addressed to AFIT administrators and faculty. There is no such limit, however, on the recommendations for future research.

Recommendations for the AFIT Administrators and Faculty

All AFIT administrators and faculty members should be made aware of the conclusions reached from this research. Specifically, the following are recommendations for the use of the research findings:

- (1) The learning methods, techniques, and devices which are not related to cognitive style type and are instead significantly "most" and "least" preferred by all types should be of particular interest to school faculty. When available time, class materials and facilities, and course objectives permit, use of the "most" preferred and

avoidance of the "least" preferred learning MTDs which cross all types may help to maximize the learning experiences of the students.

(2) The research results do show that significant diversity exists among the four cognitive style types in terms of learning MTD preferences. Although it would be somewhat difficult for the faculty to attempt to accommodate the varying preferences within their classes for learning MTDs associated with course material presentation, it would often be less difficult to do so for learning MTDs which are normally used to evaluate student performance. These MTDs include "Case Study", "Examination", "Exercises", "Group Projects", "Homework Assignments", "Oral Reports", "Pop Quiz", and "Term Paper." All of these learning MTDs were significantly preferred ("most" and/or "least") by at least one of the four MBTI cognitive style types.

One method which can be used to appeal to the varying preferences of the students is a "menu" style evaluation process. With this approach, the instructor offers the students a list of acceptable evaluation options and allows each student to select an appropriate number from the list. A second possible method is the "student-defined, instructor-approved" project, which allows the student to choose and define his or her major evaluation project for the class subject to the approval and/or modification by the instructor. And another tactic which attempts to address different student learning preferences is permitting

students to work on assigned projects either individually or within small groups and affording them the option of selecting those groups and group members.

(3) The answers to Investigative Questions 5 and 6 clearly show that student preferences for learning MTDs are modified during the graduate school educational process. The answers do not, however, explain why or how the changes occur. It is likely that students are exposed to many different learning MTDs, some for the first time. It is also probable that one of the school program objectives is to broaden student learning abilities by requiring them to apply a variety of techniques. Administrators and faculty should discuss this objective and the faculty should specifically address it while planning and executing their course objectives.

(4) As mentioned in Chapter I of this thesis, some research findings indicate that students who are briefed on their learning styles prior to the beginning of an instructional program perform better than those who are not. AFIT should continue to administer the MBTI and LSS to all graduate school classes. Also, during the pre-test outbriefing, a short presentation which addresses the purpose of the surveys, the concept of learning style, and the graduate school objective of broadening and improving individual learning styles should be included in addition to the current practice of distributing and discussing the MBTI feedback reports. Some of the conclusions from this

research might be helpful in illustrating certain points concerning learning style.

(5) Finally, the results from this research should be used to provide new skills to the faculty for assessing student learning preferences and employing the various learning MTDs to make the learning process more effective.

Recommendations for Future Research

This study produces several possibilities for further research. The recommendations which follow are listed by the group or organization which should conduct or sponsor the research.

Association for Psychological Type (APT). The answers to Investigative Question 2 determined that the research population is significantly different from that of the general population as estimated by the SRI International Values and Lifestyles (VALS) program. There are other general population estimates available, all of which result in similar findings. Because the MBTI is often used in educational settings, it would be useful if APT would coordinate efforts to establish a national database stratified by student category. For example, this research would have benefited greatly had there been an estimate of the MBTI cognitive style types of business school graduate students to compare with the research population.

Department of Defense (DOD). The MBTI is administered by other DOD education and training organizations. For

example, the Army Combined Arms Service and Staff School at Fort Leavenworth, Kansas administers the MBTI to all resident students. The DOD should consolidate all MBTI data from all DOD organizations which administer the survey into one large database. This database would serve a wide variety of purposes, including providing information concerning the cognitive style distribution of military officers and civilian managers.

AFIT Research. There are several areas for continuing the research begun with this thesis. Some of these areas can be pursued with the data which already exists, and others will require additional data. Each of these areas is discussed below:

(1) The Learning Style Survey should continue to be tested for reliability and validity in order to improve its credentials as a viable learning style measurement instrument. In particular, the LSS should be tested for internal reliability, construct validity (which began with this thesis), and predictive validity.

(2) The answer to Investigative Question 4 shows that the distribution of student cognitive style types changes significantly during the period of time of the AFIT graduate school educational process. Further research should be conducted in an attempt to determine why and how these changes occur. The post-test LSS contains an attachment which asks students for their comments concerning various teaching methods and learning techniques. Also, each

graduate school course requires students to complete a critique. Data from these documents, combined with the MBTI data, could provide researchers with a start in this area.

(3) This research used, as the independent variable, MBTI cognitive style types. Therefore, only two of the four dichotomous MBTI scales were addressed. The other two dichotomous scales, representing the attitudes of Extraversion-Introversion and Judgement-Perception, should be analyzed for relationships to learning preferences as well. These scales produce measures which are associated with basic personality characteristics, the first component of individual learning style according to Curry's model.

(4) In approximately three years, after the MBTI and LSS data from the 1993 through 1995 classes are collected, more detailed research can be conducted concerning relationships between MBTI types and learning preferences. This research can explore the roles of MBTI dominant functions, dichotomous scale preference strength scores, and the full four-letter MBTI types. Currently, the sample size is not large enough to support adequate statistical analyses in these areas.

Summary

This thesis presents several conclusions regarding the relationships between AFIT graduate school student cognitive style types and preferences for learning methods, devices, and techniques. The findings show that both commonality and

diversity exists among the four cognitive style types regarding learning preferences. This research should be used as a basis for building a greater understanding of this area. Knowledge is a valuable resource learned through practical experience and formal education and training. Any steps which can enhance the capability of creating and acquiring knowledge should be encouraged.

Appendix A: LSS Test-Retest Reliability Results and Calculations

Results:

Pre-Test MTD (by Code) Choices Post-Test MTD (by Code) Choices

Case	"Most Preferred"	"Least Preferred"	"Most Preferred"	"Least Preferred"	Pt
1	AD D F E B	Z X AA AG S	AD F H J O	V AA U I Q	3
2	R W F N V	X A AG AB AC	F W R K AG	Q Z AA Z X	4
3	F O J W Z	H B V L M	F W N O I	V H P K L	6
4	H F J Q AA	AC M E S N	U F T J B	AC Y O M S	5
5	N F O J B	AC Z Y AB AA	AD O N F W	S AA AC H AG	5
6	U R N AE O	AC Y AG F V	AA U O J P	V S AC Y M	5
7	H J G O F	R Q Z U V	H W F G N	Z I Q R V	7
8	T K O D B	R E X V AC	T O AA P K	R V X H AC	7
9	F B A AG AB	V S A Z R	F B P X O	V H I R Q	4
10	J O N A AH	V B M Z S	O E D L U	V A H M B	4
11	R U G J Q	O E Y N Z	P AB H I V	AD AC Y V O	2
12	AD AC J O T	H V U AE C	AD AC O J M	U V AE H R	8
13	O K N P AC	V X Z I S	E O P U O	X Z AE V AC	5
14	F W G N K	AC AA L B Z	G F N D O	Z L E AC AA	7
15	F N P W B	L A R U Y	P W U N F	H O AG R L	6
16	O N D T W	AA AB AE I V	O N D T W	AA AB AE I V	10
17	F AC AD T J	U A L Z I	C J AD F T	L U Z L AG	7
18	AC AD B F J	O U Y C L	AC AD J G F	U V Y H L	7
19	M AC E B H	U AA AG S R	J N AC E B	A U AB AE L	4
20	AC E F J N	V H AG L Q	E AC AD F N	AG AB AA U H	6
21	J AC AD M O	U A AE V R	AC J AD M F	A U V R AB	8
22	AD AC O M F	Z I AF AA V	AC AD M O F	Z I V H U	8
23	O N K F G	I Q H AE Z	J O G F K	I Q Z V AB	7
24	U AG K P V	E I AB AE N	AG K G P F	Q AB AE AC Z	5
25	F J T U B	I L X Z AE	F AD J G B	I AE K Q V	5
26	W P N K D	Z V I X AE	W D K N P	Z V AC Q I	8
27	J AD P AH D	M U S I AE	J AD AH P Q	I AC Z V M	6
28	AG D P N E	Q R V L AB	D N P G AB	R F L Q A	6
29	AB S G Q H	Z Y X A F	AB G U Q H	Y A I Z C	7
30	AB R C E J	D Y Z V H	P N J M AB	V Y H AF AH	5
31	F AF AB G J	M AA A L AA	F G C E D	T M W X Z	3
32	D F AB P M	V Z AE E H	D AD AB W O	H V AE Z AH	6
33	P N B J F	Z AE D L V	P J N B F	L Y Z AF R	7
34	B N J W K	AF V X H Q	B P N J R	V Q X H I	7
35	N Y C B K	H V AE Q U	D N G C W	H V AE Z U	6
36	O AC AD M J	AA A H AH I	O AC M AD K	R C AA H I	7
37	N M Q AC E	I A H J H	M A N E F	I J Q V U	5
38	D F B A AF	V Y R N AB	N P D A B	Y Z V X AE	5
39	R D B S O	U P Z Q A	R N Q AD B	U A V Z I	5
40	N G S D AE	R J V U Z	E D G N Y	Z V H R U	7
41	B F P J N	V H AE R I	B F P J N	V H A R I	9
42	P F S U N	K C L M AC	P U S N AB	B AC Y X Z	5
43	N O G Q I	H S U X AE	F N K W C	V AE H Q X	4

Explanations:

Each "Case" represents one of the sample members.

One point is assigned for each match between a pre-test "most preferred" or "least preferred" MTD and a corresponding post-test selection. There are a total of ten possible points for each case (five "most preferred" MTD matches and five "least preferred" MTD matches).

Test-Retest Reliability Calculation:

Total Actual Points = 253

Total Possible Points = 430 (43 X 10)

Test-Retest Reliability = $253 / 430 = .5884 = 58.84\%$

MTD Letter Code Legend:

<u>MTD Code</u>	<u>MTD Description</u>
A	Blackboard
B	Case Study
C	Computer Assisted Instruction
D	Confer w/Other Students
E	Debate
F	Demonstration
G	Discuss w/Instructor
H	Drill and Repetition
I	Examination
J	Exercises
K	Films/Video Tapes
L	Flipcharts
M	Games
N	Group Discussion
O	Group Projects
P	Guest Lecturer/Speaker
Q	Homework Assignments
R	Independent Study
S	Interviews
T	Laboratory
U	Lecture
V	Memorization
W	Observation
X	Oral Reports
Y	Peer Teaching
Z	Pop Quiz
AA	Programmed Instruction
AB	Reading
AC	Role Play
AD	Simulations
AE	Term Paper
AF	Tutorial
AG	View Graphs
AH	Worksheets

Appendix B: Calculations and Results for Chi-Squared
Analyses of the Sample Distributions of MBTI Cognitive Style
Types to the SRI Estimates of the General Population

Total Sample Distribution:

<u>MBTI Type</u>	<u>Observed Frequency</u>	<u>Observed Number</u>	<u>Expected Frequency*</u>	<u>Expected Number</u>	<u>Chi-Squared TS Values</u>
ST	52.55%	278	52.60%	278.254	0.0002
SF	11.72%	62	20.96%	110.878	21.5467
NT	29.30%	155	16.87%	89.242	48.4538
NF	6.43%	34	9.57%	50.625	5.4596
Totals	100.00%	529	100.00%	528.999	75.4603

* The SRI frequencies were recalculated for this research to reflect a ratio of males to females which equals that of the total sample.

Sample Males Distribution:

<u>MBTI Type</u>	<u>Observed Frequency</u>	<u>Observed Number</u>	<u>Expected Frequency</u>	<u>Expected Number</u>	<u>Chi-Squared TS Values</u>
ST	53.80%	248	56.30%	259.543	0.5134
SF	10.85%	50	16.60%	76.526	9.1946
NT	29.28%	135	18.40%	84.824	29.6806
NF	6.07%	28	8.70%	40.107	3.6547
Totals	100.00%	461	100.00%	461.000	43.0433

Sample Females Distribution:

<u>MBTI Type</u>	<u>Observed Frequency</u>	<u>Observed Number</u>	<u>Expected Frequency</u>	<u>Expected Number</u>	<u>Chi-Squared TS Values</u>
ST	44.12%	30	27.50%	18.700	6.8283
SF	17.65%	12	50.50%	34.340	14.5334
NT	29.41%	20	6.50%	4.420	54.9177
NF	8.82%	6	15.50%	10.540	1.9556
Totals	100.00%	68	100.00%	68.000	78.2350

Appendix C: Calculations and Results for the Chi-Squared Analyses of the
Pre-Test Learning MTD Preference Distributions for the Total Sample and
Four Cognitive Style Types

Total Sample: "Most Preferred"

	Observed Number of Times Selected	Observed Relative Frequency	Expected Number of Times Selected	Expected Relative Frequency	Distrib- ution Chi-Squared TS Value
<u>Learning MTD</u>					
BLACKBOARD	59	0.0223	77.79	0.0294	4.5404
CASE STUDY	121	0.0457	77.79	0.0294	23.9960
COMPUTER-ASSISTED INSTR	66	0.0250	77.79	0.0294	1.7881
CONFER W/OTHER STUDENTS	128	0.0484	77.79	0.0294	32.4013
DEBATE	74	0.0280	77.79	0.0294	0.1850
DEMONSTRATION	253	0.0957	77.79	0.0294	394.5941
DISCUSS W/INSTRUCTOR	191	0.0722	77.79	0.0294	164.7370
DRILL AND REPETITION	42	0.0159	77.79	0.0294	16.4694
EXAMINATION	29	0.0110	77.79	0.0294	30.6047
EXERCISES	125	0.0473	77.79	0.0294	28.6448
FILMS/VIDEOTAPES	67	0.0253	77.79	0.0294	1.4977
FLIPCHARTS	2	0.0008	77.79	0.0294	73.8455
GAMES	59	0.0223	77.79	0.0294	4.5404
GROUP DISCUSSION	205	0.0775	77.79	0.0294	208.0021
GROUP PROJECTS	96	0.0363	77.79	0.0294	4.2607
GUEST LECTURER/SPEAKER	115	0.0435	77.79	0.0294	17.7941
HOMEWORK ASSIGNMENTS	105	0.0397	77.79	0.0294	9.5143
INDEPENDENT STUDY	96	0.0363	77.79	0.0294	4.2607
INTERVIEWS	11	0.0042	77.79	0.0294	57.3495
LABORATORY	106	0.0401	77.79	0.0294	10.2266
LECTURE	112	0.0423	77.79	0.0294	15.0402
MEMORIZATION	22	0.0083	77.79	0.0294	40.0157
OBSERVATION	102	0.0386	77.79	0.0294	7.5317
ORAL REPORTS	15	0.0057	77.79	0.0294	50.6864
PEER TEACHING	33	0.0125	77.79	0.0294	25.7926
POP QUIZ	7	0.0026	77.79	0.0294	64.4240
PROGRAMMED INSTRUCTION	29	0.0110	77.79	0.0294	30.6047
READING	106	0.0401	77.79	0.0294	10.2266
ROLE PLAY	61	0.0231	77.79	0.0294	3.6255
SIMULATIONS	112	0.0423	77.79	0.0294	15.0402
TERM PAPERS	20	0.0076	77.79	0.0294	42.9359
TUTORIAL	26	0.0098	77.79	0.0294	34.4837
VIEW GRAPHS	22	0.0083	77.79	0.0294	40.0157
WORKSHEETS	26	0.0098	77.79	0.0294	34.4837
TOTALS*	2643	0.9992	2645.00	1.0000	1504.1592

* The observed totals do not equal the expected totals because not all sample members used all five of their selections.

ST: "Most Preferred"

	Observed Number of Times Selected	Observed Relative Frequency	Expected Number of Times Selected	Expected Relative Frequency	Distrib- ution Chi-Squared TS Value
<u>Learning MTD</u>					
BLACKBOARD	40	0.0288	40.88	0.0294	0.0190
CASE STUDY	62	0.0446	40.88	0.0294	10.9083
COMPUTER-ASSISTED INSTR	39	0.0281	40.88	0.0294	0.0867
CONFER W/OTHER STUDENTS	65	0.0468	40.88	0.0294	14.2277
DEBATE	34	0.0245	40.88	0.0294	1.1586
DEMONSTRATION	133	0.0957	40.88	0.0294	207.5629
DISCUSS W/INSTRUCTOR	100	0.0719	40.88	0.0294	85.4867
DRILL AND REPITITION	27	0.0194	40.88	0.0294	4.7140
EXAMINATION	19	0.0137	40.88	0.0294	11.7126
EXERCISES	83	0.0597	40.88	0.0294	43.3903
FILMS/VIDEOTAPES	34	0.0245	40.88	0.0294	1.1586
FLIPCHARTS	2	0.0014	40.88	0.0294	36.9802
GAMES	29	0.0209	40.88	0.0294	3.4536
GROUP DISCUSSION	100	0.0719	40.88	0.0294	85.4867
GROUP PROJECTS	50	0.0360	40.88	0.0294	2.0334
GUEST LECTURER/SPEAKER	61	0.0439	40.88	0.0294	9.8996
HOMEWORK ASSIGNMENTS	67	0.0482	40.88	0.0294	16.6852
INDEPENDENT STUDY	45	0.0324	40.88	0.0294	0.4147
INTERVIEWS	4	0.0029	40.88	0.0294	33.2737
LABORATORY	55	0.0396	40.88	0.0294	4.8752
LECTURE	57	0.0410	40.88	0.0294	6.3543
MEMORIZATION	12	0.0086	40.88	0.0294	20.4047
OBSERVATION	47	0.0338	40.88	0.0294	0.9154
ORAL REPORTS	7	0.0050	40.88	0.0294	28.0809
PEER TEACHING	14	0.0101	40.88	0.0294	17.6766
POP QUIZ	4	0.0029	40.88	0.0294	33.2737
PROGRAMMED INSTRUCTION	14	0.0101	40.88	0.0294	17.6766
READING	52	0.0374	40.88	0.0294	3.0234
ROLE PLAY	25	0.0180	40.88	0.0294	6.1701
SIMULATIONS	61	0.0439	40.88	0.0294	9.8996
TERM PAPERS	7	0.0050	40.88	0.0294	28.0809
TUTORIAL	14	0.0101	40.88	0.0294	17.6766
VIEW GRAPHS	12	0.0086	40.88	0.0294	20.4047
WORKSHEETS	15	0.0108	40.88	0.0294	16.3860
TOTALS	1390	1.0000	1390.00	1.0000	799.5511

SP: "Most Preferred"

	Observed Number of Times Selected	Observed Relative Frequency	Expected Number of Times Selected	Expected Relative Frequency	Distrib- ution Chi-Squared TS Value
<u>Learning MTD</u>					
BLACKBOARD	6	0.0194	9.12	0.0294	1.0660
CASE STUDY	13	0.0419	9.12	0.0294	1.6531
COMPUTER-ASSISTED INSTR	8	0.0258	9.12	0.0294	0.1370
CONFER W/OTHER STUDENTS	18	0.0581	9.12	0.0294	8.6531
DEBATE	8	0.0258	9.12	0.0294	0.1370
DEMONSTRATION	31	0.1000	9.12	0.0294	52.5176
DISCUSS W/INSTRUCTOR	23	0.0742	9.12	0.0294	21.1370
DRILL AND REPITITION	5	0.0161	9.12	0.0294	1.8596
EXAMINATION	3	0.0097	9.12	0.0294	4.1047
EXERCISES	12	0.0387	9.12	0.0294	0.9112
FILMS/VIDEOTAPES	12	0.0387	9.12	0.0294	0.9112
FLIPCHARTS	0	0.0000	9.12	0.0294	9.1176
GAMES	12	0.0387	9.12	0.0294	0.9112
GROUP DISCUSSION	20	0.0645	9.12	0.0294	12.9886
GROUP PROJECTS	14	0.0452	9.12	0.0294	2.6144
GUEST LECTURER/SPEAKER	12	0.0387	9.12	0.0294	0.9112
HOMEWORK ASSIGNMENTS	10	0.0323	9.12	0.0294	0.0854
INDEPENDENT STUDY	9	0.0290	9.12	0.0294	0.0015
INTERVIEWS	1	0.0032	9.12	0.0294	7.2273
LABORATORY	8	0.0258	9.12	0.0294	0.1370
LECTURE	12	0.0387	9.12	0.0294	0.9112
MEMORIZATION	1	0.0032	9.12	0.0294	7.2273
OBSERVATION	18	0.0581	9.12	0.0294	8.6531
ORAL REPORTS	1	0.0032	9.12	0.0294	7.2273
PEER TEACHING	5	0.0161	9.12	0.0294	1.8596
POP QUIZ	1	0.0032	9.12	0.0294	7.2273
PROGRAMMED INSTRUCTION	6	0.0194	9.12	0.0294	1.0660
READING	9	0.0290	9.12	0.0294	0.0015
ROLE PLAY	6	0.0194	9.12	0.0294	1.0660
SIMULATIONS	11	0.0355	9.12	0.0294	0.3886
TERM PAPERS	3	0.0097	9.12	0.0294	4.1047
TUTORIAL	5	0.0161	9.12	0.0294	1.8596
VIEW GRAPHS	3	0.0097	9.12	0.0294	4.1047
WORKSHEETS	4	0.0129	9.12	0.0294	2.8725
TOTALS	310	1.0000	310.00	1.0000	175.6516

NT: "Most Preferred"

	Observed Number of Times Selected	Observed Relative Frequency	Expected Number of Times Selected	Expected Relative Frequency	Distrib- ution Chi-Squared TS Value
<u>Learning MTD</u>					
BLACKBOARD	9	0.0116	22.79	0.0294	8.3477
CASE STUDY	34	0.0439	22.79	0.0294	5.5090
COMPUTER-ASSISTED INSTR	17	0.0219	22.79	0.0294	1.4728
CONFER W/OTHER STUDENTS	37	0.0477	22.79	0.0294	8.8535
DEBATE	30	0.0387	22.79	0.0294	2.2780
DEMONSTRATION	77	0.0994	22.79	0.0294	128.9051
DISCUSS W/INSTRUCTOR	61	0.0787	22.79	0.0294	64.0380
DRILL AND REPITITION	6	0.0077	22.79	0.0294	12.3735
EXAMINATION	7	0.0090	22.79	0.0294	10.9438
EXERCISES	26	0.0335	22.79	0.0294	0.4509
FILMS/VIDEOTAPES	15	0.0194	22.79	0.0294	2.6651
FLIPCHARTS	0	0.0000	22.79	0.0294	22.7941
GAMES	13	0.0168	22.79	0.0294	4.2083
GROUP DISCUSSION	71	0.0916	22.79	0.0294	101.9477
GROUP PROJECTS	27	0.0348	22.79	0.0294	0.7761
GUEST LECTURER/SPEAKER	32	0.0413	22.79	0.0294	3.7180
HOMEWORK ASSIGNMENTS	20	0.0258	22.79	0.0294	0.3425
INDEPENDENT STUDY	34	0.0439	22.79	0.0294	5.5090
INTERVIEWS	4	0.0052	22.79	0.0294	15.4961
LABORATORY	37	0.0477	22.79	0.0294	8.8535
LECTURE	33	0.0426	22.79	0.0294	4.5696
MEMORIZATION	4	0.0052	22.79	0.0294	15.4961
OBSERVATION	31	0.0400	22.79	0.0294	2.9541
ORAL REPORTS	6	0.0077	22.79	0.0294	12.3735
PEER TEACHING	13	0.0168	22.79	0.0294	4.2083
POP QUIZ	2	0.0026	22.79	0.0294	18.9696
PROGRAMMED INSTRUCTION	8	0.0103	22.79	0.0294	9.6019
READING	34	0.0439	22.79	0.0294	5.5090
ROLE PLAY	22	0.0284	22.79	0.0294	0.0277
SIMULATIONS	34	0.0439	22.79	0.0294	5.5090
TERM PAPERS	9	0.0116	22.79	0.0294	8.3477
TUTORIAL	7	0.0090	22.79	0.0294	10.9438
VIEW GRAPHS	7	0.0090	22.79	0.0294	10.9438
WORKSHEETS	6	0.0077	22.79	0.0294	12.3735
TOTALS*	773	0.9974	775.00	1.0000	531.3097

* The observed totals do not equal the expected totals because not all sample members used all five of their selections.

NF: "Most Preferred"

	Observed Number of Times Selected	Observed Relative Frequency	Expected Number of Times Selected	Expected Relative Frequency	Distrib- ution Chi-Squared TS Value
<u>Learning MTD</u>					
BLACKBOARD	4	0.0235	5.00	0.0294	0.2000
CASE STUDY	12	0.0706	5.00	0.0294	9.8000
COMPUTER-ASSISTED INSTR	2	0.0118	5.00	0.0294	1.8000
CONFER W/OTHER STUDENTS	8	0.0471	5.00	0.0294	1.8000
DEBATE	2	0.0118	5.00	0.0294	1.8000
DEMONSTRATION	12	0.0706	5.00	0.0294	9.8000
DISCUSS W/INSTRUCTOR	7	0.0412	5.00	0.0294	0.8000
DRILL AND REPITITION	4	0.0235	5.00	0.0294	0.2000
EXAMINATION	0	0.0000	5.00	0.0294	5.0000
EXERCISES	4	0.0235	5.00	0.0294	0.2000
FILMS/VIDEOTAPES	6	0.0353	5.00	0.0294	0.2000
FLIPCHARTS	0	0.0000	5.00	0.0294	5.0000
GAMES	5	0.0294	5.00	0.0294	0.0000
GROUP DISCUSSION	14	0.0824	5.00	0.0294	16.2000
GROUP PROJECTS	5	0.0294	5.00	0.0294	0.0000
GUEST LECTURER/SPEAKER	10	0.0588	5.00	0.0294	5.0000
HOMEWORK ASSIGNMENTS	8	0.0471	5.00	0.0294	1.8000
INDEPENDENT STUDY	8	0.0471	5.00	0.0294	1.8000
INTERVIEWS	2	0.0118	5.00	0.0294	1.8000
LABORATORY	6	0.0353	5.00	0.0294	0.2000
LECTURE	10	0.0588	5.00	0.0294	5.0000
MEMORIZATION	5	0.0294	5.00	0.0294	0.0000
OBSERVATION	6	0.0353	5.00	0.0294	0.2000
ORAL REPORTS	1	0.0059	5.00	0.0294	3.2000
PEER TEACHING	1	0.0059	5.00	0.0294	3.2000
POP QUIZ	0	0.0000	5.00	0.0294	5.0000
PROGRAMMED INSTRUCTION	1	0.0059	5.00	0.0294	3.2000
READING	11	0.0647	5.00	0.0294	7.2000
ROLE PLAY	8	0.0471	5.00	0.0294	1.8000
SIMULATIONS	6	0.0353	5.00	0.0294	0.2000
TERM PAPERS	1	0.0059	5.00	0.0294	3.2000
TUTORIAL	0	0.0000	5.00	0.0294	5.0000
VIEW GRAPHS	0	0.0000	5.00	0.0294	5.0000
WORKSHEETS	1	0.0059	5.00	0.0294	3.2000
TOTALS	170	1.0000	170.00	1.0000	108.8000

Total Sample: "Least Preferred"

	Observed Number of Times Selected	Observed Relative Frequency	Expected Number of Times Selected	Expected Relative Frequency	Distrib- ution Chi-Squared TS Value
<u>Learning MTD</u>					
BLACKBOARD	78	0.0295	77.79	0.0294	0.0005
CASE STUDY	44	0.0166	77.79	0.0294	14.6803
COMPUTER-ASSISTED INSTR	55	0.0208	77.79	0.0294	6.6788
CONFER W/OTHER STUDENTS	46	0.0174	77.79	0.0294	12.9941
DEBATE	92	0.0348	77.79	0.0294	2.5941
DEMONSTRATION	4	0.0015	77.79	0.0294	69.9998
DISCUSS W/INSTRUCTOR	20	0.0076	77.79	0.0294	42.9359
DRILL AND REPITITION	163	0.0616	77.79	0.0294	93.3238
EXAMINATION	92	0.0348	77.79	0.0294	2.5941
EXERCISES	15	0.0057	77.79	0.0294	50.6864
FILMS/VIDEOTAPES	68	0.0257	77.79	0.0294	1.2331
FLIPCHARTS	90	0.0340	77.79	0.0294	1.9151
GAMES	85	0.0321	77.79	0.0294	0.6675
GROUP DISCUSSION	60	0.0227	77.79	0.0294	4.0701
GROUP PROJECTS	101	0.0382	77.79	0.0294	6.9223
GUEST LECTURER/SPEAKER	48	0.0181	77.79	0.0294	11.4108
HOMEWORK ASSIGNMENTS	40	0.0151	77.79	0.0294	18.3612
INDEPENDENT STUDY	50	0.0189	77.79	0.0294	9.9302
INTERVIEWS	55	0.0208	77.79	0.0294	6.6788
LABORATORY	35	0.0132	77.79	0.0294	23.5408
LECTURE	107	0.0405	77.79	0.0294	10.9646
MEMORIZATION	250	0.0945	77.79	0.0294	381.1968
OBSERVATION	18	0.0068	77.79	0.0294	45.9590
ORAL REPORTS	123	0.0465	77.79	0.0294	26.2690
PEER TEACHING	116	0.0439	77.79	0.0294	18.7635
POP QUIZ	226	0.0854	77.79	0.0294	282.3476
PROGRAMMED INSTRUCTION	87	0.0329	77.79	0.0294	1.0894
READING	48	0.0181	77.79	0.0294	11.4108
ROLE PLAY	132	0.0499	77.79	0.0294	37.7699
SIMULATIONS	26	0.0098	77.79	0.0294	34.4837
TERM PAPERS	126	0.0476	77.79	0.0294	29.8712
TUTORIAL	31	0.0117	77.79	0.0294	28.1472
VIEW GRAPHS	71	0.0268	77.79	0.0294	0.5934
WORKSHEETS	37	0.0140	77.79	0.0294	21.3918
TOTALS*	2639	0.9977	2645.00	1.0000	1311.4756

* The observed totals do not equal the expected totals because not all sample members used all five of their selections.

ST: "Least Preferred"

	Observed Number of Times Selected	Observed Relative Frequency	Expected Number of Times Selected	Expected Relative Frequency	Distrib- ution Chi-Squared TS Value
<u>Learning MTD</u>					
BLACKBOARD	41	0.0295	40.88	0.0294	0.0003
CASE STUDY	27	0.0194	40.88	0.0294	4.7140
COMPUTER-ASSISTED INSTR	26	0.0187	40.88	0.0294	5.4176
CONFER W/OTHER STUDENTS	25	0.0180	40.88	0.0294	6.1701
DEBATE	55	0.0396	40.88	0.0294	4.8752
DEMONSTRATION	2	0.0014	40.88	0.0294	36.9802
DISCUSS W/INSTRUCTOR	11	0.0079	40.88	0.0294	21.8421
DRILL AND REPITITION	75	0.0540	40.88	0.0294	28.4723
EXAMINATION	43	0.0309	40.88	0.0294	0.1097
EXERCISES	6	0.0043	40.88	0.0294	29.7629
FILMS/VIDEOTAPES	41	0.0295	40.88	0.0294	0.0003
FLIPCHARTS	43	0.0309	40.88	0.0294	0.1097
GAMES	48	0.0345	40.88	0.0294	1.2392
GROUP DISCUSSION	36	0.0259	40.88	0.0294	0.5831
GROUP PROJECTS	55	0.0396	40.88	0.0294	4.8752
GUEST LECTURER/SPEAKER	26	0.0187	40.88	0.0294	5.4176
HOMEWORK ASSIGNMENTS	18	0.0129	40.88	0.0294	12.8075
INDEPENDENT STUDY	26	0.0187	40.88	0.0294	5.4176
INTERVIEWS	30	0.0216	40.88	0.0294	2.8967
LABORATORY	24	0.0173	40.88	0.0294	6.9716
LECTURE	51	0.0367	40.88	0.0294	2.5039
MEMORIZATION	127	0.0914	40.88	0.0294	181.4047
OBSERVATION	10	0.0072	40.88	0.0294	23.3284
ORAL REPORTS	77	0.0554	40.88	0.0294	31.9083
PEER TEACHING	69	0.0496	40.88	0.0294	19.3385
POP QUIZ	114	0.0820	40.88	0.0294	130.7701
PROGRAMMED INSTRUCTION	36	0.0259	40.88	0.0294	0.5831
READING	26	0.0187	40.88	0.0294	5.4176
ROLE PLAY	72	0.0518	40.88	0.0294	23.6852
SIMULATIONS	13	0.0094	40.88	0.0294	19.0162
TERM PAPERS	65	0.0468	40.88	0.0294	14.2277
TUTORIAL	17	0.0122	40.88	0.0294	13.9514
VIEW GRAPHS	32	0.0230	40.88	0.0294	1.9298
WORKSHEETS	20	0.0144	40.88	0.0294	10.6665
TOTALS*	1387	0.9978	1390.00	1.0000	657.3942

* The observed totals do not equal the expected totals because not all sample members used all five of their selections.

SF: "Least Preferred"

	Observed Number of Times Selected	Observed Relative Frequency	Expected Number of Times Selected	Expected Relative Frequency	Distrib- ution Chi-Squared TS Value
<u>Learning MTD</u>					
BLACKBOARD	10	0.0323	9.12	0.0294	0.0854
CASE STUDY	6	0.0194	9.12	0.0294	1.0660
COMPUTER-ASSISTED INSTR	8	0.0258	9.12	0.0294	0.1370
CONFER W/OTHER STUDENTS	5	0.0161	9.12	0.0294	1.8596
DEBATE	19	0.0613	9.12	0.0294	10.7112
DEMONSTRATION	2	0.0065	9.12	0.0294	5.5564
DISCUSS W/INSTRUCTOR	4	0.0129	9.12	0.0294	2.8725
DRILL AND REPETITION	17	0.0548	9.12	0.0294	6.8144
EXAMINATION	15	0.0484	9.12	0.0294	3.7951
EXERCISES	1	0.0032	9.12	0.0294	7.2273
FILMS/VIDEOTAPES	9	0.0290	9.12	0.0294	0.0015
FLIPCHARTS	10	0.0323	9.12	0.0294	0.0854
GAMES	4	0.0129	9.12	0.0294	2.8725
GROUP DISCUSSION	4	0.0129	9.12	0.0294	2.8725
GROUP PROJECTS	11	0.0355	9.12	0.0294	0.3886
GUEST LECTURER/SPEAKER	8	0.0258	9.12	0.0294	0.1370
HOMEWORK ASSIGNMENTS	5	0.0161	9.12	0.0294	1.8596
INDEPENDENT STUDY	4	0.0129	9.12	0.0294	2.8725
INTERVIEWS	9	0.0290	9.12	0.0294	0.0015
LABORATORY	3	0.0097	9.12	0.0294	4.1047
LECTURE	17	0.0548	9.12	0.0294	6.8144
MEMORIZATION	26	0.0839	9.12	0.0294	31.2596
OBSERVATION	1	0.0032	9.12	0.0294	7.2273
ORAL REPORTS	15	0.0484	9.12	0.0294	3.7951
PEER TEACHING	15	0.0484	9.12	0.0294	3.7951
POP QUIZ	27	0.0871	9.12	0.0294	35.0725
PROGRAMMED INSTRUCTION	10	0.0323	9.12	0.0294	0.0854
READING	8	0.0258	9.12	0.0294	0.1370
ROLE PLAY	7	0.0226	9.12	0.0294	0.4918
SIMULATIONS	2	0.0065	9.12	0.0294	5.5564
TERM PAPERS	15	0.0484	9.12	0.0294	3.7951
TUTORIAL	1	0.0032	9.12	0.0294	7.2273
VIEW GRAPHS	7	0.0226	9.12	0.0294	0.4918
WORKSHEETS	5	0.0161	9.12	0.0294	1.8596
TOTALS	310	1.0000	310.00	1.0000	162.9290

NT: "Least Preferred"

	Observed Number of Times Selected	Observed Relative Frequency	Expected Number of Times Selected	Expected Relative Frequency	Distrib- ution Chi-Squared TS Value
<u>Learning MTD</u>					
BLACKBOARD	23	0.0297	22.79	0.0294	0.0019
CASE STUDY	9	0.0116	22.79	0.0294	8.3477
COMPUTER-ASSISTED INSTR	16	0.0206	22.79	0.0294	2.0251
CONFER W./OTHER STUDENTS	13	0.0168	22.79	0.0294	4.2083
DEBATE	10	0.0129	22.79	0.0294	7.1812
DEMONSTRATION	0	0.0000	22.79	0.0294	22.7941
DISCUSS W/INSTRUCTOR	5	0.0065	22.79	0.0294	13.8909
DRILL AND REPITITION	60	0.0774	22.79	0.0294	60.7296
EXAMINATION	27	0.0348	22.79	0.0294	0.7761
EXERCISES	7	0.0090	22.79	0.0294	10.9438
FILMS/VIDEOTAPES	15	0.0194	22.79	0.0294	2.6651
FLIPCHARTS	31	0.0400	22.79	0.0294	2.9541
GAMES	30	0.0387	22.79	0.0294	2.2780
GROUP DISCUSSION	16	0.0206	22.79	0.0294	2.0251
GROUP PROJECTS	27	0.0348	22.79	0.0294	0.7761
GUEST LECTURER/SPEAKER	11	0.0142	22.79	0.0294	6.1025
HOMEWORK ASSIGNMENTS	14	0.0181	22.79	0.0294	3.3928
INDEPENDENT STUDY	15	0.0194	22.79	0.0294	2.6651
INTERVIEWS	15	0.0194	22.79	0.0294	2.6651
LABORATORY	6	0.0077	22.79	0.0294	12.3735
LECTURE	31	0.0400	22.79	0.0294	2.9541
MEMORIZATION	83	0.1071	22.79	0.0294	159.0212
OBSERVATION	6	0.0077	22.79	0.0294	12.3735
ORAL REPORTS	29	0.0374	22.79	0.0294	1.6896
PEER TEACHING	28	0.0361	22.79	0.0294	1.1890
POP QUIZ	68	0.0877	22.79	0.0294	89.6535
PROGRAMMED INSTRUCTION	32	0.0413	22.79	0.0294	3.7180
READING	12	0.0155	22.79	0.0294	5.1115
ROLE PLAY	39	0.0503	22.79	0.0294	11.5219
SIMULATIONS	9	0.0116	22.79	0.0294	8.3477
TERM PAPERS	38	0.0490	22.79	0.0294	10.1438
TUTORIAL	12	0.0155	22.79	0.0294	5.1115
VIEW GRAPHS	25	0.0323	22.79	0.0294	0.2135
WORKSHEETS	<u>10</u>	<u>0.0129</u>	<u>22.79</u>	<u>0.0294</u>	<u>7.1812</u>
TOTALS*	772	0.9961	775.00	1.0000	487.0258

* The observed totals do not equal the expected totals because not all sample members used all five of their selections.

NP: "Least Preferred"

	Observed Number of Times Selected	Observed Relative Frequency	Expected Number of Times Selected	Expected Relative Frequency	Distrib- ution Chi-Squared TS Value
<u>Learning MTD</u>					
BLACKBOARD	4	0.0235	5.00	0.0294	0.2000
CASE STUDY	2	0.0118	5.00	0.0294	1.8000
COMPUTER-ASSISTED INSTR	5	0.0294	5.00	0.0294	0.0000
CONFER W/OTHER STUDENTS	3	0.0176	5.00	0.0294	0.8000
DEBATE	8	0.0471	5.00	0.0294	1.8000
DEMONSTRATION	0	0.0000	5.00	0.0294	5.0000
DISCUSS W/INSTRUCTOR	0	0.0000	5.00	0.0294	5.0000
DRILL AND REPITITION	11	0.0647	5.00	0.0294	7.2000
EXAMINATION	7	0.0412	5.00	0.0294	0.8000
EXERCISES	1	0.0059	5.00	0.0294	3.2000
FILMS/VIDEOTAPES	3	0.0176	5.00	0.0294	0.8000
FLIPCHARTS	6	0.0353	5.00	0.0294	0.2000
GAMES	3	0.0176	5.00	0.0294	0.8000
GROUP DISCUSSION	4	0.0235	5.00	0.0294	0.2000
GROUP PROJECTS	8	0.0471	5.00	0.0294	1.8000
GUEST LECTURER/SPEAKER	3	0.0176	5.00	0.0294	0.8000
HOMEWORK ASSIGNMENTS	3	0.0176	5.00	0.0294	0.8000
INDEPENDENT STUDY	5	0.0294	5.00	0.0294	0.0000
INTERVIEWS	1	0.0059	5.00	0.0294	3.2000
LABORATORY	2	0.0118	5.00	0.0294	1.8000
LECTURE	8	0.0471	5.00	0.0294	1.8000
MEMORIZATION	14	0.0824	5.00	0.0294	16.2000
OBSERVATION	1	0.0059	5.00	0.0294	3.2000
ORAL REPORTS	2	0.0118	5.00	0.0294	1.8000
PEER TEACHING	4	0.0235	5.00	0.0294	0.2000
POP QUIZ	17	0.1000	5.00	0.0294	28.8000
PROGRAMMED INSTRUCTION	9	0.0529	5.00	0.0294	3.2000
READING	2	0.0118	5.00	0.0294	1.8000
ROLE PLAY	14	0.0824	5.00	0.0294	16.2000
SIMULATIONS	2	0.0118	5.00	0.0294	1.8000
TERM PAPERS	8	0.0471	5.00	0.0294	1.8000
TUTORIAL	1	0.0059	5.00	0.0294	3.2000
VIEW GRAPHS	7	0.0412	5.00	0.0294	0.8000
WORKSHEETS	2	0.0118	5.00	0.0294	1.8000
TOTALS	170	1.0000	170.00	1.0000	118.8000

Appendix D: Calculations and Results for Chi-Squared Analyses to Isolate
Pre-Test Learning MTD Preferences

Total Sample: "Most Preferred"

<u>Learning MTD</u>	<u>Observed Number of Times Selected</u>	<u>Expected Number of Times Selected</u>	<u>Chi- Squared Test Statistic</u>	<u>Lvl of Signif- icance*</u>
BLACKBOARD	59	77.79	5.3233	NA
CASE STUDY	121	77.79	28.1333	****
COMPUTER-ASSISTED INSTRUCTION	66	77.79	2.0964	NA
CONFER W/OTHER STUDENTS	128	77.79	37.9877	****
DEBATE	74	77.79	0.2169	NA
DEMONSTRATION	253	77.79	462.6276	****
DISCUSS W/INSTRUCTOR	191	77.79	193.1400	****
DRILL AND REPETITION	42	77.79	19.3089	NA
EXAMINATION	29	77.79	35.8814	NA
EXERCISES	125	77.79	33.5835	****
FILMS/VIDEOTAPES	67	77.79	1.7559	NA
FLIPCHARTS	2	77.79	86.5775	NA
GAMES	59	77.79	5.3233	NA
GROUP DISCUSSION	205	77.79	243.8645	****
GROUP PROJECTS	96	77.79	4.9953	*
GUEST LECTURER/SPEAKER	115	77.79	20.8621	****
HOMEWORK ASSIGNMENTS	105	77.79	11.1547	***
INDEPENDENT STUDY	96	77.79	4.9953	*
INTERVIEWS	11	77.79	67.2374	NA
LABORATORY	106	77.79	11.9898	***
LECTURE	112	77.79	17.6334	****
MEMORIZATION	22	77.79	46.9149	NA
OBSERVATION	102	77.79	8.8303	**
ORAL REPORTS	15	77.79	59.4254	NA
PEER TEACHING	33	77.79	30.2396	NA
POP QUIZ	7	77.79	75.5316	NA
PROGRAMMED INSTRUCTION	29	77.79	35.8814	NA
READING	106	77.79	11.9898	***
ROLE PLAY	61	77.79	4.2506	NA
SIMULATIONS	112	77.79	17.6334	****
TERM PAPERS	20	77.79	50.3386	NA
TUTORIAL	26	77.79	40.4292	NA
VIEW GRAPHS	22	77.79	46.9149	NA
WORKSHEETS	26	77.79	40.4292	NA
TOTALS**	2643	2645.00		

<u>* Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

** Observed totals do not equal expected totals because not all sample members used all five of their selections.

ST: "Most Preferred"

	Observed Number of Times Selected	Expected Number of Times Selected	Chi- Squared Test Statistic	Lvl of Signif- icance*
<u>Learning MTD</u>				
BLACKBOARD	40	40.88	0.0223	NA
CASE STUDY	62	40.88	12.7890	***
COMPUTER-ASSISTED INSTRUCTION	39	40.88	0.1016	NA
CONFER W/OTHER STUDENTS	65	40.88	16.6807	****
DEBATE	34	40.88	1.3584	NA
DEMONSTRATION	133	40.88	243.3496	****
DISCUSS W/INSTRUCTOR	100	40.88	100.2258	****
DRILL AND REPETITION	27	40.88	5.5268	NA
EXAMINATION	19	40.88	13.7320	NA
EXERCISES	83	40.88	50.8713	****
FILMS/VIDEOTAPES	34	40.88	1.3584	NA
FLIPCHARTS	2	40.88	43.3561	NA
GAMES	29	40.88	4.0490	NA
GROUP DISCUSSION	100	40.88	100.2258	****
GROUP PROJECTS	50	40.88	2.3840	NA
GUEST LECTURER/SPEAKER	61	40.88	11.6065	***
HOMEWORK ASSIGNMENTS	67	40.88	19.5620	****
INDEPENDENT STUDY	45	40.88	0.4862	NA
INTERVIEWS	4	40.88	39.0106	NA
LABORATORY	55	40.88	5.7157	*
LECTURE	57	40.88	7.4499	**
MEMORIZATION	12	40.88	23.9227	NA
OBSERVATION	47	40.88	1.0733	NA
ORAL REPORTS	7	40.88	32.9225	NA
PEER TEACHING	14	40.88	20.7243	NA
POP QUIZ	4	40.88	39.0106	NA
PROGRAMMED INSTRUCTION	14	40.88	20.7243	NA
READING	52	40.88	3.5446	NA
ROLE PLAY	25	40.88	7.2339	NA
SIMULATIONS	61	40.88	11.6065	***
TERM PAPERS	7	40.88	32.9225	NA
TUTORIAL	14	40.88	20.7243	NA
VIEW GRAPHS	12	40.88	23.9227	NA
WORKSHEETS	15	40.88	19.2111	NA
TOTALS	1390	1390.00		

* Level of Significance

p < .05
P < .01
P < .001
P < .0001
Not Applicable

Symbol

*
**

NA

SF: "Most Preferred"

<u>Learning MTD</u>	<u>Observed Number of Times Selected</u>	<u>Expected Number of Times Selected</u>	<u>Chi- Squared Test Statistic</u>	<u>Lvl of Signif- icance*</u>
BLACKBOARD	6	9.12	1.2498	NA
CASE STUDY	13	9.12	1.9382	NA
COMPUTER-ASSISTED INSTRUCTION	8	9.12	0.1606	NA
CONFER W/OTHER STUDENTS	18	9.12	10.1451	**
DEBATE	8	9.12	0.1606	NA
DEMONSTRATION	31	9.12	61.5724	****
DISCUSS W/INSTRUCTOR	23	9.12	24.7813	****
DRILL AND REPITITION	5	9.12	2.1802	NA
EXAMINATION	3	9.12	4.8125	NA
EXERCISES	12	9.12	1.0683	NA
FILMS/VIDEOTAPES	12	9.12	1.0683	NA
FLIPCHARTS	0	9.12	10.6897	NA
GAMES	12	9.12	1.0683	NA
GROUP DISCUSSION	20	9.12	15.2280	****
GROUP PROJECTS	14	9.12	3.0652	NA
GUEST LECTURER/SPEAKER	12	9.12	1.0683	NA
HOMEWORK ASSIGNMENTS	10	9.12	0.1001	NA
INDEPENDENT STUDY	9	9.12	0.0018	NA
INTERVIEWS	1	9.12	8.4734	NA
LABORATORY	8	9.12	0.1606	NA
LECTURE	12	9.12	1.0683	NA
MEMORIZATION	1	9.12	8.4734	NA
OBSERVATION	18	9.12	10.1451	**
ORAL REPORTS	1	9.12	8.4734	NA
PEER TEACHING	5	9.12	2.1802	NA
POP QUIZ	1	9.12	8.4734	NA
PROGRAMMED INSTRUCTION	6	9.12	1.2498	NA
READING	9	9.12	0.0018	NA
ROLE PLAY	6	9.12	1.2498	NA
SIMULATIONS	11	9.12	0.4556	NA
TERM PAPERS	3	9.12	4.8125	NA
TUTORIAL	5	9.12	2.1802	NA
VIEW GRAPHS	3	9.12	4.8125	NA
WORKSHEETS	4	9.12	3.3677	NA
TOTALS	310	310.00		

* Level of Significance

Symbol

p < .05

*

P < .01

**

P < .001

P < .0001

Not Applicable

NA

NT: "Most Preferred"

	Observed Number of Times Selected	Expected Number of Times Selected	Chi- Squared Test Statistic	Lvl of Signif- icance*
<u>Learning MTD</u>				
BLACKBOARD	9	22.79	9.7869	NA
CASE STUDY	34	22.79	6.4588	*
COMPUTER-ASSISTED INSTRUCTION	17	22.79	1.7268	NA
CONFER W/OTHER STUDENTS	37	22.79	10.3799	**
DEBATE	30	22.79	2.6707	NA
DEMONSTRATION	77	22.79	151.1301	****
DISCUSS W/INSTRUCTOR	61	22.79	75.0790	****
DRILL AND REPITITION	6	22.79	14.5068	NA
EXAMINATION	7	22.79	12.8307	NA
EXERCISES	26	22.79	0.5286	NA
FILMS/VIDEOTAPES	15	22.79	3.1246	NA
FLIPCHARTS	0	22.79	26.7241	NA
GAMES	13	22.79	4.9339	NA
GROUP DISCUSSION	71	22.79	119.5248	****
GROUP PROJECTS	27	22.79	0.9099	NA
GUEST LECTURER/SPEAKER	32	22.79	4.3590	*
HOMEWORK ASSIGNMENTS	20	22.79	0.4016	NA
INDEPENDENT STUDY	34	22.79	6.4588	*
INTERVIEWS	4	22.79	18.1678	NA
LABORATORY	37	22.79	10.3799	**
LECTURE	33	22.79	5.3575	*
MEMORIZATION	4	22.79	18.1678	NA
OBSERVATION	31	22.79	3.4634	NA
ORAL REPORTS	6	22.79	14.5068	NA
PEER TEACHING	13	22.79	4.9339	NA
POP QUIZ	2	22.79	22.2402	NA
PROGRAMMED INSTRUCTION	8	22.79	11.2574	NA
READING	34	22.79	6.4588	*
ROLE PLAY	22	22.79	0.0324	NA
SIMULATIONS	34	22.79	6.4588	*
TERM PAPERS	9	22.79	9.7869	NA
TUTORIAL	7	22.79	12.8307	NA
VIEW GRAPHS	7	22.79	12.8307	NA
WORKSHEETS	6	22.79	14.5068	NA
TOTALS**	773	775.00		

* Level of Significance	Symbol
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

** Observed totals do not equal expected totals because not all sample members used all five of their selections.

NF: "Most Preferred"

	Observed Number of Times Selected	Expected Number of Times Selected	Chi- Squared Test Statistic	Lvl of Signif- icance*
<u>Learning MTD</u>				
BLACKBOARD	4	5.00	0.2345	NA
CASE STUDY	12	5.00	11.4897	***
COMPUTER-ASSISTED INSTRUCTION	2	5.00	2.1103	NA
CONFER W/OTHER STUDENTS	8	5.00	2.1103	NA
DEBATE	2	5.00	2.1103	NA
DEMONSTRATION	12	5.00	11.4897	***
DISCUSS W/INSTRUCTOR	7	5.00	0.9379	NA
DRILL AND REPETITION	4	5.00	0.2345	NA
EXAMINATION	0	5.00	5.8621	NA
EXERCISES	4	5.00	0.2345	NA
FILMS/VIDEOTAPES	6	5.00	0.2345	NA
FLIPCHARTS	0	5.00	5.8621	NA
GAMES	5	5.00	0.0000	NA
GROUP DISCUSSION	14	5.00	18.9931	****
GROUP PROJECTS	5	5.00	0.0000	NA
GUEST LECTURER/SPEAKER	10	5.00	5.8621	*
HOMEWORK ASSIGNMENTS	8	5.00	2.1103	NA
INDEPENDENT STUDY	8	5.00	2.1103	NA
INTERVIEWS	2	5.00	2.1103	NA
LABORATORY	6	5.00	0.2345	NA
LECTURE	10	5.00	5.8621	*
MEMORIZATION	5	5.00	0.0000	NA
OBSERVATION	6	5.00	0.2345	NA
ORAL REPORTS	1	5.00	3.7517	NA
PEER TEACHING	1	5.00	3.7517	NA
POP QUIZ	0	5.00	5.8621	NA
PROGRAMMED INSTRUCTION	1	5.00	3.7517	NA
READING	11	5.00	8.4414	**
ROLE PLAY	8	5.00	2.1103	NA
SIMULATIONS	6	5.00	0.2345	NA
TERM PAPERS	1	5.00	3.7517	NA
TUTORIAL	0	5.00	5.8621	NA
VIEW GRAPHS	0	5.00	5.8621	NA
WORKSHEETS	1	5.00	3.7517	NA
TOTALS	170	170.00		

* Level of Significance

p < .05
P < .01
P < .001
P < .0001
Not Applicable

Symbol

*
**

NA

Total Sample: "Least Preferred"

	Observed Number of Times Selected	Expected Number of Times Selected	Chi- Squared Test Statistic	Lvl of Signif- icance*
<u>Learning MTD</u>				
BLACKBOARD	78	77.79	0.0006	NA
CASE STUDY	44	77.79	17.2114	NA
COMPUTER-ASSISTED INSTRUCTION	55	77.79	7.8303	NA
CONFER W/OTHER STUDENTS	46	77.79	15.2345	NA
DEBATE	92	77.79	3.0414	NA
DEMONSTRATION	4	77.79	82.0687	NA
DISCUSS W/INSTRUCTOR	20	77.79	50.3386	NA
DRILL AND REPETITION	163	77.79	109.4141	****
EXAMINATION	92	77.79	3.0414	NA
EXERCISES	15	77.79	59.4254	NA
FILMS/VIDEOTAPES	68	77.79	1.4457	NA
FLIPCHARTS	90	77.79	2.2453	NA
GAMES	85	77.79	0.7825	NA
GROUP DISCUSSION	60	77.79	4.7719	NA
GROUP PROJECTS	101	77.79	8.1158	**
GUEST LECTURER/SPEAKER	48	77.79	13.3781	NA
HOMEWORK ASSIGNMENTS	40	77.79	21.5270	NA
INDEPENDENT STUDY	50	77.79	11.6423	NA
INTERVIEWS	55	77.79	7.8303	NA
LABORATORY	35	77.79	27.5996	NA
LECTURE	107	77.79	12.8551	***
MEMORIZATION	250	77.79	446.9203	****
OBSERVATION	18	77.79	53.8829	NA
ORAL REPORTS	123	77.79	30.7981	****
PEER TEACHING	116	77.79	21.9986	****
POP QUIZ	226	77.79	331.0282	****
PROGRAMMED INSTRUCTION	87	77.79	1.2772	NA
READING	48	77.79	13.3781	NA
ROLE PLAY	132	77.79	44.2820	****
SIMULATIONS	26	77.79	40.4292	NA
TERM PAPERS	126	77.79	35.0215	****
TUTORIAL	31	77.79	33.0002	NA
VIEW GRAPHS	71	77.79	0.6957	NA
WORKSHEETS	37	77.79	25.0801	NA
TOTALS**	2639	2645.00		

* <u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

** Observed totals do not equal expected totals because not all sample members used all five of their selections.

ST: "Least Preferred"

<u>Learning MTD</u>	<u>Observed Number of Times Selected</u>	<u>Expected Number of Times Selected</u>	<u>Chi- Squared Test Statistic</u>	<u>Lvl of Signif- icance*</u>
BLACKBOARD	41	40.88	0.0004	NA
CASE STUDY	27	40.88	5.5268	NA
COMPUTER-ASSISTED INSTRUCTION	26	40.88	6.3517	NA
CONFER W/OTHER STUDENTS	25	40.88	7.2339	NA
DEBATE	55	40.88	5.7157	*
DEMONSTRATION	2	40.88	43.3561	NA
DISCUSS W/INSTRUCTOR	11	40.88	25.6079	NA
DRILL AND REPETITION	75	40.88	33.3813	****
EXAMINATION	43	40.88	0.1286	NA
EXERCISES	6	40.88	34.8945	NA
FILMS/VIDEOTAPES	41	40.88	0.0004	NA
FLIPCHARTS	43	40.88	0.1286	NA
GAMES	48	40.88	1.4528	NA
GROUP DISCUSSION	36	40.88	0.6836	NA
GROUP PROJECTS	55	40.88	5.7157	*
GUEST LECTURER/SPEAKER	26	40.88	6.3517	NA
HOMEWORK ASSIGNMENTS	18	40.88	15.0157	NA
INDEPENDENT STUDY	26	40.88	6.3517	NA
INTERVIEWS	30	40.88	3.3962	NA
LABORATORY	24	40.88	8.1736	NA
LECTURE	51	40.88	2.9356	NA
MEMORIZATION	127	40.88	212.6813	****
OBSERVATION	10	40.88	27.3505	NA
ORAL REPORTS	77	40.88	37.4097	****
PEER TEACHING	69	40.88	22.6727	****
POP QUIZ	114	40.88	153.3167	****
PROGRAMMED INSTRUCTION	36	40.88	0.6836	NA
READING	26	40.88	6.3517	NA
ROLE PLAY	72	40.88	27.7689	****
SIMULATIONS	13	40.88	22.2948	NA
TERM PAPERS	65	40.88	16.6807	****
TUTORIAL	17	40.88	16.3568	NA
VIEW GRAPHS	32	40.88	2.2626	NA
WORKSHEETS	20	40.88	12.5056	NA
TOTALS**	1387	1390.00		

<u>* Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

** Observed totals do not equal expected totals because not all sample members used all five of their selections.

SF: "Least Preferred"

	Observed Number of Times Selected	Expected Number of Times Selected	Chi- Squared Test Statistic	Lvl of Signif- icance*
<u>Learning MTD</u>				
BLACKBOARD	10	9.12	0.1001	NA
CASE STUDY	6	9.12	1.2498	NA
COMPUTER-ASSISTED INSTRUCTION	8	9.12	0.1606	NA
CONFER W/OTHER STUDENTS	5	9.12	2.1802	NA
DEBATE	19	9.12	12.5580	***
DEMONSTRATION	2	9.12	6.5143	NA
DISCUSS W/INSTRUCTOR	4	9.12	3.3677	NA
DRILL AND REPETITION	17	9.12	7.9893	**
EXAMINATION	15	9.12	4.4494	*
EXERCISES	1	9.12	8.4734	NA
FILMS/VIDEOTAPES	9	9.12	0.0018	NA
FLIPCHARTS	10	9.12	0.1001	NA
GAMES	4	9.12	3.3677	NA
GROUP DISCUSSION	4	9.12	3.3677	NA
GROUP PROJECTS	11	9.12	0.4556	NA
GUEST LECTURER/SPEAKER	8	9.12	0.1606	NA
HOMEWORK ASSIGNMENTS	5	9.12	2.1802	NA
INDEPENDENT STUDY	4	9.12	3.3677	NA
INTERVIEWS	9	9.12	0.0018	NA
LABORATORY	3	9.12	4.8125	NA
LECTURE	17	9.12	7.9893	**
MEMORIZATION	26	9.12	36.6492	****
OBSERVATION	1	9.12	8.4734	NA
ORAL REPORTS	15	9.12	4.4494	*
PEER TEACHING	15	9.12	4.4494	*
POP QUIZ	27	9.12	41.1195	****
PROGRAMMED INSTRUCTION	10	9.12	0.1001	NA
READING	8	9.12	0.1606	NA
ROLE PLAY	7	9.12	0.5766	NA
SIMULATIONS	2	9.12	6.5143	NA
TERM PAPERS	15	9.12	4.4494	*
TUTORIAL	1	9.12	8.4734	NA
VIEW GRAPHS	7	9.12	0.5766	NA
WORKSHEETS	5	9.12	2.1802	NA
TOTALS	310	310.00		

* Level of Significance

Symbol

p < .05

*

P < .01

**

P < .001

P < .0001

Not Applicable

NA

NT: "Least Preferred"

<u>Learning MTD</u>	<u>Observed Number of Times Selected</u>	<u>Expected Number of Times Selected</u>	<u>Chi- Squared Test Statistic</u>	<u>Lvl of Signif- icance*</u>
BLACKBOARD	23	22.79	0.0022	NA
CASE STUDY	9	22.79	9.7869	NA
COMPUTER-ASSISTED INSTRUCTION	16	22.79	2.3742	NA
CONFER W/OTHER STUDENTS	13	22.79	4.9339	NA
DEBATE	10	22.79	8.4194	NA
DEMONSTRATION	0	22.79	26.7241	NA
DISCUSS W/INSTRUCTOR	5	22.79	16.2859	NA
DRILL AND REPITITION	60	22.79	71.2002	****
EXAMINATION	27	22.79	0.9099	NA
EXERCISES	7	22.79	12.8307	NA
FILMS/VIDEOTAPES	15	22.79	3.1246	NA
FLIPCHARTS	31	22.79	3.4634	NA
GAMES	30	22.79	2.6707	NA
GROUP DISCUSSION	16	22.79	2.3742	NA
GROUP PROJECTS	27	22.79	0.9099	NA
GUEST LECTURER/SPEAKER	11	22.79	7.1547	NA
HOMEWORK ASSIGNMENTS	14	22.79	3.9778	NA
INDEPENDENT STUDY	15	22.79	3.1246	NA
INTERVIEWS	15	22.79	3.1246	NA
LABORATORY	6	22.79	14.5068	NA
LECTURE	31	22.79	3.4634	NA
MEMORIZATION	83	22.79	186.4387	****
OBSERVATION	6	22.79	14.5068	NA
ORAL REPORTS	29	22.79	1.9809	NA
PEER TEACHING	28	22.79	1.3939	NA
POP QUIZ	68	22.79	105.1110	****
PROGRAMMED INSTRUCTION	32	22.79	4.3590	*
READING	12	22.79	5.9928	NA
ROLE PLAY	39	22.79	13.5084	***
SIMULATIONS	9	22.79	9.7869	NA
TERM PAPERS	38	22.79	11.8927	***
TUTORIAL	12	22.79	5.9928	NA
VIEW GRAPHS	25	22.79	0.2503	NA
WORKSHEETS	10	22.79	8.4194	NA
TOTALS**	772	775.00		

<u>* Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

** Observed totals do not equal expected totals because not all sample members used all five of their selections.

NF: "Least Preferred"

	Observed Number of Times Selected	Expected Number of Times Selected	Chi- Squared Test Statistic	Lvl of Signif- icance*
<u>Learning MTD</u>				
BLACKBOARD	4	5.00	0.2345	NA
CASE STUDY	2	5.00	2.1103	NA
COMPUTER-ASSISTED INSTRUCTION	5	5.00	0.0000	NA
CONFER W/OTHER STUDENTS	3	5.00	0.9379	NA
DEBATE	8	5.00	2.1103	NA
DEMONSTRATION	0	5.00	5.8621	NA
DISCUSS W/INSTRUCTOR	0	5.00	5.8621	NA
DRILL AND REPETITION	11	5.00	8.4414	**
EXAMINATION	7	5.00	0.9379	NA
EXERCISES	1	5.00	3.7517	NA
FILMS/VIDEOTAPES	3	5.00	0.9379	NA
FLIPCHARTS	6	5.00	0.2345	NA
GAMES	3	5.00	0.9379	NA
GROUP DISCUSSION	4	5.00	0.2345	NA
GROUP PROJECTS	8	5.00	2.1103	NA
GUEST LECTURER/SPEAKER	3	5.00	0.9379	NA
HOMEWORK ASSIGNMENTS	3	5.00	0.9379	NA
INDEPENDENT STUDY	5	5.00	0.0000	NA
INTERVIEWS	1	5.00	3.7517	NA
LABORATORY	2	5.00	2.1103	NA
LECTURE	8	5.00	2.1103	NA
MEMORIZATION	14	5.00	18.9931	****
OBSERVATION	1	5.00	3.7517	NA
ORAL REPORTS	2	5.00	2.1103	NA
PEER TEACHING	4	5.00	0.2345	NA
POP QUIZ	17	5.00	33.7655	****
PROGRAMMED INSTRUCTION	9	5.00	3.7517	NA
READING	2	5.00	2.1103	NA
ROLE PLAY	14	5.00	18.9931	****
SIMULATIONS	2	5.00	2.1103	NA
TERM PAPERS	8	5.00	2.1103	NA
TUTORIAL	1	5.00	3.7517	NA
VIEW GRAPHS	7	5.00	0.9379	NA
WORKSHEETS	2	5.00	2.1103	NA
TOTALS	170	170.00		

* <u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

Appendix E: Calculations and Results for Chi-Squared Analyses Comparing
the Learning MTD Preference Distributions of the Cognitive Style Types
and Isolating the Significantly Different Learning MTDs

ST to SF: "Most Preferred"

<u>Learning MTD</u>	<u>SF Observed Number of Times Selected</u>	<u>SF Expected Number Based ST Freq</u>	<u>Distri- bution Chi- Squared TS Value</u>	<u>MTD Chi- Squared TS</u>	<u>Level of Significance</u>
BLACKBOARD	6	8.92	0.9563	1.1171	NA
CASE STUDY	13	13.83	0.0495	0.0637	NA
COMPUTER-ASSISTED INSTR	8	8.70	0.0560	0.0651	NA
CONFER W/OTHER STUDENTS	18	14.50	0.8468	1.1052	NA
DEBATE	8	7.58	0.0230	0.0262	NA
DEMONSTRATION	31	29.66	0.0604	0.1157	NA
DISCUSS W/INSTRUCTOR	23	22.30	0.0218	0.0341	NA
DRILL AND REPETITION	5	6.02	0.1733	0.1920	NA
EXAMINATION	3	4.24	0.3613	0.3879	NA
EXERCISES	12	18.51	2.2900	3.2648	NA
FILMS/VIDEOTAPES	12	7.58	2.5732	2.9318	NA
FLIPCHARTS	0	0.45	0.4460	0.4493	NA
GAMES	12	6.47	4.7324	5.2835	NA
GROUP DISCUSSION	20	22.30	0.2376	0.3711	NA
GROUP PROJECTS	14	11.15	0.7279	0.8875	NA
GUEST LECTURER/SPEAKER	12	13.60	0.1892	0.2424	NA
HOMEWORK ASSIGNMENTS	10	14.94	1.6348	2.1539	NA
INDEPENDENT STUDY	9	10.04	0.1069	0.1276	NA
INTERVIEWS	1	0.89	0.0131	0.0132	NA
LABORATORY	8	12.27	1.4838	1.8497	NA
LECTURE	12	12.71	0.0399	0.0502	NA
MEMORIZATION	1	2.68	1.0499	1.0973	NA
OBSERVATION	18	10.48	5.3921	6.4892	*
ORAL REPORTS	1	1.56	0.2017	0.2069	NA
PEER TEACHING	5	3.12	1.1292	1.1891	NA
POP QUIZ	1	0.89	0.0131	0.0132	NA
PROGRAMMED INSTRUCTION	6	3.12	2.6523	2.7929	NA
READING	9	11.60	0.5816	0.7154	NA
ROLE PLAY	6	5.58	0.0323	0.0355	NA
SIMULATIONS	11	13.60	0.4986	0.6387	NA
TERM PAPERS	3	1.56	1.3261	1.3604	NA
TUTORIAL	5	3.12	1.1292	1.1891	NA
VIEW GRAPHS	3	2.68	0.0392	0.0409	NA
WORKSHEETS	4	3.35	0.1281	0.1354	NA
TOTALS	310	310.00	31.1966		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable	NA

ST to NT: "Most Preferred"

	NT Observed Number of Times Selected	NT Expected Number Based ST Freq	Distrib- ution Chi- Squared TS Value	MTD Chi- Squared TS	Level of Significance
<u>Learning MTD</u>					
BLACKBOARD	9	22.30	7.9341	9.2676	NA
CASE STUDY	34	34.57	0.0093	0.0120	NA
COMPUTER-ASSISTED INSTR	17	21.74	1.0353	1.2042	NA
CONFER W/OTHER STUDENTS	37	36.24	0.0159	0.0207	NA
DEBATE	30	18.96	6.4331	7.3295	NA
DEMONSTRATION	77	74.15	0.1092	0.2093	NA
DISCUSS W/INSTRUCTOR	61	55.76	0.4933	0.7705	NA
DRILL AND REPITITION	6	15.05	5.4454	6.0311	NA
EXAMINATION	7	10.59	1.2190	1.3084	NA
EXERCISES	26	46.28	8.8847	12.6664	***
FILMS/VIDEOTAPES	15	18.96	0.8259	0.9410	NA
FLIPCHARTS	0	1.12	1.1151	1.1232	NA
GAMES	13	16.17	0.6211	0.6935	NA
GROUP DISCUSSION	71	55.76	4.1682	6.5098	*
GROUP PROJECTS	27	27.88	0.0276	0.0337	NA
GUEST LECTURER/SPEAKER	32	34.01	0.1189	0.1523	NA
HOMEWORK ASSIGNMENTS	20	37.36	8.0639	10.6244	**
INDEPENDENT STUDY	34	25.09	3.1642	3.7753	NA
INTERVIEWS	4	2.23	1.4044	1.4249	NA
LABORATORY	37	30.67	1.3085	1.6312	NA
LECTURE	33	31.78	0.0468	0.0589	NA
MEMORIZATION	4	6.69	1.0820	1.1309	NA
OBSERVATION	31	26.21	0.8774	1.0559	NA
ORAL REPORTS	6	3.90	1.1268	1.1559	NA
PEER TEACHING	13	7.81	3.4564	3.6397	NA
POP QUIZ	2	2.23	0.0238	0.0241	NA
PROGRAMMED INSTRUCTION	8	7.81	0.0048	0.0051	NA
READING	34	28.99	0.8648	1.0637	NA
ROLE PLAY	22	13.94	4.6619	5.1226	NA
SIMULATIONS	34	34.01	0.0000	0.0000	NA
TERM PAPERS	9	3.90	6.6568	6.8287	NA
TUTORIAL	7	7.81	0.0832	0.0876	NA
VIEW GRAPHS	7	6.69	0.0143	0.0149	NA
WORKSHEETS	6	8.36	0.6678	0.7059	NA
TOTALS**	773	775.00	71.9640		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable	NA

ST to NF: "Most Preferred"

	NF Observed Number of Times Selected	NF Expected Number Based ST Freq	Distribution Chi- Squared TS Value	MTD Chi- Squared TS	Level of Significance
<u>Learning MTD</u>					
BLACKBOARD	4	4.89	0.1627	0.1900	NA
CASE STUDY	12	7.58	2.5732	3.3119	NA
COMPUTER-ASSISTED INSTR	2	4.77	1.6084	1.8709	NA
CONFER W/OTHER STUDENTS	8	7.95	0.0003	0.0004	NA
DEBATE	2	4.16	1.1202	1.2763	NA
DEMONSTRATION	12	16.27	1.1189	2.1452	NA
DISCUSS W/INSTRUCTOR	7	12.23	2.2367	3.4933	NA
DRILL AND REPETITION	4	3.30	0.1475	0.1633	NA
EXAMINATION	0	2.32	2.3237	2.4942	NA
EXERCISES	4	10.15	3.7273	5.3137	*
FILMS/VIDEOTAPES	6	4.16	0.8157	0.9294	NA
FLIPCHARTS	0	0.24	0.2446	0.2464	NA
GAMES	5	3.55	0.5954	0.6648	NA
GROUP DISCUSSION	14	12.23	0.2561	0.4000	NA
GROUP PROJECTS	5	6.12	0.2033	0.2479	NA
GUEST LECTURER/SPEAKER	10	7.46	0.8645	1.1075	NA
HOMEWORK ASSIGNMENTS	8	8.19	0.0046	0.0061	NA
INDEPENDENT STUDY	8	5.50	1.1324	1.3511	NA
INTERVIEWS	2	0.49	4.6657	4.7338	NA
LABORATORY	6	6.73	0.0785	0.0978	NA
LECTURE	10	6.97	1.3159	1.6553	NA
MEMORIZATION	5	1.47	8.5019	8.8855	NA
OBSERVATION	6	5.75	0.0110	0.0133	NA
ORAL REPORTS	1	0.86	0.0242	0.0248	NA
PEER TEACHING	1	1.71	0.2963	0.3120	NA
POP QUIZ	0	0.49	0.4892	0.4964	NA
PROGRAMMED INSTRUCTION	1	1.71	0.2963	0.3120	NA
READING	11	6.36	3.3857	4.1647	*
ROLE PLAY	8	3.06	7.9893	8.7788	NA
SIMULATIONS	6	7.46	0.2859	0.3663	NA
TERM PAPERS	1	0.86	0.0242	0.0248	NA
TUTORIAL	0	1.71	1.7122	1.8030	NA
VIEW GRAPHS	0	1.47	1.4676	1.5338	NA
WORKSHEETS	1	1.83	0.3796	0.4013	NA
TOTALS	170	170.00	50.0591		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable	NA

SF to NF: "Most Preferred"

	NF Observed Number of Times Selected	NF Expected Number Based SF Freq	Distribution Chi- Squared TS Value	MTD Chi- Squared TS	Level of Significance
<u>Learning MTD</u>					
BLACKBOARD	4	3.29	0.1531	0.1695	NA
CASE STUDY	12	7.13	3.3281	4.2111	*
COMPUTER-ASSISTED INSTR	2	4.39	1.2989	1.4913	NA
CONFER W/OTHER STUDENTS	8	9.87	0.3546	0.4997	NA
DEBATE	2	4.39	1.2989	1.4913	NA
DEMONSTRATION	12	17.00	1.4706	2.9412	NA
DISCUSS W/INSTRUCTOR	7	12.61	2.4978	3.9709	*
DRILL AND REPITITION	4	2.74	0.5772	0.6279	NA
EXAMINATION	0	1.65	1.6452	1.7288	NA
EXERCISES	4	6.58	1.0120	1.2549	NA
FILMS/VIDEOTAPES	6	6.58	0.0512	0.0635	NA
FLIPCHARTS	0	0.00	0.0000	0.0000	NA
GAMES	5	6.58	0.3797	0.4708	NA
GROUP DISCUSSION	14	10.97	0.8383	1.2375	NA
GROUP PROJECTS	5	7.68	0.9337	1.2061	NA
GUEST LECTURER/SPEAKER	10	6.58	1.7767	2.2031	NA
HOMEWORK ASSIGNMENTS	8	5.48	1.1545	1.3765	NA
INDEPENDENT STUDY	8	4.94	1.9028	2.2259	NA
INTERVIEWS	2	0.55	3.8425	3.9055	NA
LABORATORY	6	4.39	0.5930	0.6808	NA
LECTURE	10	6.58	1.7767	2.2031	NA
MEMORIZATION	5	0.55	36.1366	36.7290	NA
OBSERVATION	6	9.87	1.5180	2.1390	NA
ORAL REPORTS	1	0.55	0.3719	0.3780	NA
PEER TEACHING	1	2.74	1.1066	1.2037	NA
POP QUIZ	0	0.55	0.5484	0.5574	NA
PROGRAMMED INSTRUCTION	1	3.29	1.5942	1.7651	NA
READING	11	4.94	7.4518	8.7172	**
ROLE PLAY	8	3.29	6.7413	7.4636	NA
SIMULATIONS	6	6.03	0.0002	0.0002	NA
TERM PAPERS	1	1.65	0.2530	0.2659	NA
TUTORIAL	0	2.74	2.7419	2.9825	NA
VIEW GRAPHS	0	1.65	1.6452	1.7288	NA
WORKSHEETS	1	2.19	0.6494	0.6942	NA
TOTALS	170	170.00	87.6442		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable	NA

NT to SF: "Most Preferred"

	SF Observed Number of Times Selected	SF Expected Number Based NT Freq	Distribution Chi- Squared TS Value	MTD Chi- Squared TS	Level of Significance
<u>Learning MTD</u>					
BLACKBOARD	6	3.60	1.6000	1.6986	NA
CASE STUDY	13	13.60	0.0265	0.0339	NA
COMPUTER-ASSISTED INSTR	8	6.80	0.2118	0.2379	NA
CONFER W/OTHER STUDENTS	18	14.80	0.6919	0.9088	NA
DEBATE	8	12.00	1.3333	1.6533	NA
DEMONSTRATION	31	30.80	0.0013	0.0026	NA
DISCUSS W/INSTRUCTOR	23	24.40	0.0803	0.1325	NA
DRILL AND REPETITION	5	2.40	2.8167	2.9301	NA
EXAMINATION	3	2.80	0.0143	0.0150	NA
EXERCISES	12	10.40	0.2462	0.2958	NA
FILMS/VIDEOTAPES	12	6.00	6.0000	6.6429	NA
FLIPCHARTS	0	0.00	0.0000	0.0000	NA
GAMES	12	5.20	8.8923	9.7064	NA
GROUP DISCUSSION	20	28.40	2.4845	4.5845	*
GROUP PROJECTS	14	10.80	0.9481	1.1481	NA
GUEST LECTURER/SPEAKER	12	12.80	0.0500	0.0630	NA
HOMEWORK ASSIGNMENTS	10	8.00	0.5000	0.5741	NA
INDEPENDENT STUDY	9	13.60	1.5559	1.9931	NA
INTERVIEWS	1	1.60	0.2250	0.2310	NA
LABORATORY	8	14.80	3.1243	4.1040	*
LECTURE	12	13.20	0.1091	0.1386	NA
MEMORIZATION	1	1.60	0.2250	0.2310	NA
OBSERVATION	18	12.40	2.5290	3.1613	NA
ORAL REPORTS	1	2.40	0.8167	0.8496	NA
PEER TEACHING	5	5.20	0.0077	0.0084	NA
POP QUIZ	1	0.80	0.0500	0.0507	NA
PROGRAMMED INSTRUCTION	6	3.20	2.4500	2.5833	NA
READING	9	13.60	1.5559	1.9931	NA
ROLE PLAY	6	8.80	0.8909	1.0383	NA
SIMULATIONS	11	13.60	0.4971	0.6367	NA
TERM PAPERS	3	3.60	0.1000	0.1062	NA
TUTORIAL	5	2.80	1.7286	1.8103	NA
VIEW GRAPHS	3	2.80	0.0143	0.0150	NA
WORKSHEETS	4	2.40	1.0667	1.1096	NA
TOTALS	310	309.20	42.8432		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable	NA

NT to NF: "Most Preferred"

	NF Observed Number of Times Selected	NF Expected Number Based NT Freq	Distribution Chi- Squared TS Value	MTD Chi- Squared TS	Level of Significance
<u>Learning MTD</u>					
BLACKBOARD	4	1.97	2.0788	2.2069	NA
CASE STUDY	12	7.46	2.7660	3.5433	NA
COMPUTER-ASSISTED INSTR	2	3.73	0.8017	0.9005	NA
CONFER W/OTHR STUDENTS	8	8.12	0.0017	0.0022	NA
DEBATE	2	6.58	3.1885	3.9537	NA
DEMONSTRATION	12	16.89	1.4159	2.8137	NA
DISCUSS W/INSTRUCTOR	7	13.38	3.0427	5.0171	*
DRILL AND REPETITION	4	1.32	5.4730	5.6934	NA
EXAMINATION	0	1.54	1.5355	1.6081	NA
EXERCISES	4	5.70	0.5087	0.6112	NA
FILMS/VIDEOTAPES	6	3.29	2.2315	2.4706	NA
FLIPCHARTS	0	0.00	0.0000	0.0000	NA
GAMES	5	2.85	1.6186	1.7668	NA
GROUP DISCUSSION	14	15.57	0.1591	0.2936	NA
GROUP PROJECTS	5	5.92	0.1437	0.1740	NA
GUEST LECTURER/SPEAKER	10	7.02	1.2657	1.5950	NA
HOMEWORK ASSIGNMENTS	8	4.39	2.9753	3.4161	NA
INDEPENDENT STUDY	8	7.46	0.0394	0.0504	NA
INTERVIEWS	2	0.88	1.4362	1.4743	NA
LABORATORY	6	8.12	0.5517	0.7247	NA
LECTURE	10	7.24	1.0533	1.3382	NA
MEMORIZATION	5	0.88	19.3701	19.8832	NA
OBSERVATION	6	6.80	0.0941	0.1176	NA
ORAL REPORTS	1	1.32	0.0759	0.0790	NA
PEER TEACHING	1	2.85	1.2023	1.3124	NA
POP QUIZ	0	0.44	0.4387	0.4444	NA
PROGRAMMED INSTRUCTION	1	1.75	0.3247	0.3424	NA
READING	11	7.46	1.6821	2.1548	NA
ROLE PLAY	8	4.83	2.0878	2.4332	NA
SIMULATIONS	6	7.46	0.2851	0.3652	NA
TERM PAPERS	1	1.97	0.4807	0.5104	NA
TUTORIAL	0	1.54	1.5355	1.6081	NA
VIEW GRAPHS	0	1.54	1.5355	1.6081	NA
WORKSHEETS	1	1.32	0.0759	0.0790	NA
TOTALS	170	169.56	61.4754		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable	NA

ST to SF: "Least Preferred"

	SF Observed Number of Times Selected	SF Expected Number Based ST Freq	Distribution Chi- Squared TS Value	MTD Chi- Squared TS	Level of Significance
<u>Learning MTD</u>					
BLACKBOARD	10	9.14	0.0802	0.0940	NA
CASE STUDY	6	6.02	0.0001	0.0001	NA
COMPUTER-ASSISTED INSTR	8	5.80	0.8358	0.9220	NA
CONFER W/OTHER STUDENTS	5	5.58	0.0594	0.0653	NA
DEBATE	19	12.27	3.6967	4.6084	*
DEMONSTRATION	2	0.45	5.4138	5.4530	NA
DISCUSS W/INSTRUCTOR	4	2.45	0.9752	1.0154	NA
DRILL AND REPETITION	17	16.73	0.0045	0.0061	NA
EXAMINATION	15	9.59	3.0520	3.6105	NA
EXERCISES	1	1.34	0.0854	0.0873	NA
FILMS/VIDEOTAPES	9	9.14	0.0023	0.0027	NA
FLIPCHARTS	10	9.59	0.0175	0.0207	NA
GAMES	4	10.71	4.1997	5.0761	NA
GROUP DISCUSSION	4	8.03	2.0216	2.3223	NA
GROUP PROJECTS	11	12.27	0.1307	0.1629	NA
GUEST LECTURER/SPEAKER	8	5.80	0.8358	0.9220	NA
HOMEWORK ASSIGNMENTS	5	4.01	0.2420	0.2587	NA
INDEPENDENT STUDY	4	5.80	0.5579	0.6154	NA
INTERVIEWS	9	6.69	0.7971	0.8935	NA
LABORATORY	3	5.35	1.0340	1.1317	NA
LECTURE	17	11.37	2.7827	3.4079	NA
MEMORIZATION	26	28.32	0.1906	0.3510	NA
OBSERVATION	1	2.23	0.6786	0.7039	NA
ORAL REPORTS	15	17.17	0.2749	0.3802	NA
PEER TEACHING	15	15.39	0.0098	0.0130	NA
POP QUIZ	27	25.42	0.0976	0.1655	NA
PROGRAMMED INSTRUCTION	10	8.03	0.4840	0.5560	NA
READING	8	5.80	0.8358	0.9220	NA
ROLE PLAY	7	16.06	5.1091	6.8948	**
SIMULATIONS	2	2.90	0.2789	0.2926	NA
TERM PAPERS	15	14.50	0.0175	0.0228	NA
TUTORIAL	1	3.79	2.0551	2.1890	NA
VIEW GRAPHS	7	7.14	0.0026	0.0030	NA
WORKSHEETS	5	4.46	0.0653	0.0703	NA
TOTALS	310	309.33	36.9241		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable	NA

ST to NT: "Least Preferred"

	NT Observed Number of Times Selected	NT Expected Number Based on ST Data	Distribution Chi- Squared TS Value	NTD Chi- Squared TS	Level of Significance
<u>Learning MTD</u>					
BLACKBOARD	23	22.86	0.0009	0.0010	NA
CASE STUDY	9	15.85	2.4346	2.6965	NA
COMPUTER-ASSISTED INSTRUCTION	14	14.98	0.1560	0.1720	NA
CONFER W/OTHER STUDENTS	13	13.94	0.0632	0.0695	NA
DEBATE	14	39.67	13.9265	17.3612	****
DEMONSTRATION	8	1.12	1.1151	1.1232	NA
DISCUSS W/INSTRUCTOR	5	6.13	0.2093	0.2180	NA
DRILL AND REPETITION	60	41.82	7.9069	10.8281	***
EXAMINATION	27	23.97	0.3817	0.4516	NA
EXERCISES	7	3.35	3.9926	4.0807	NA
FILMS/VIDEOTAPES	15	22.86	2.7024	3.1699	NA
FLIPCHARTS	31	23.97	2.0585	2.4352	NA
GAMES	30	26.76	0.3916	0.4734	NA
GROUP DISCUSSION	16	20.07	0.8261	0.9489	NA
GROUP PROJECTS	27	30.67	0.4381	0.5462	NA
GUEST LECTURER/SPEAKER	11	14.50	0.8433	0.9303	NA
HOMEWORK ASSIGNMENTS	14	10.04	1.5657	1.6741	NA
INDEPENDENT STUDY	15	14.50	0.0175	0.0193	NA
INTERVIEWS	15	16.73	0.1782	0.1998	NA
LABORATORY	6	13.38	4.0716	4.4563	NA
LECTURE	31	28.44	0.2313	0.2833	NA
MEMORIZATION	83	70.81	2.0988	3.8639	*
OBSERVATION	6	5.58	0.0323	0.0335	NA
ORAL REPORTS	29	42.93	4.5209	6.2528	*
PEER TEACHING	28	38.47	2.8501	3.7910	NA
POP QUIZ	68	63.56	0.3100	0.5255	NA
PROGRAMMED INSTRUCTION	32	20.07	7.0884	8.1429	**
READING	12	14.50	0.4299	0.4743	NA
ROLE PLAY	39	40.14	0.0326	0.0440	NA
SIMULATIONS	9	7.25	0.4234	0.4442	NA
TERM PAPERS	38	36.24	0.0854	0.1114	NA
TUTORIAL	12	9.48	0.6708	0.7145	NA
VIEW GRAPHS	25	17.84	2.8720	3.2456	NA
WORKSHEETS	10	11.15	0.1188	0.1280	NA
TOTALS	772	773.33	65.0446		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable	NA

ST to NF: "Least Preferred"

	NF Observed Number of Times Selected	NF Expected Number Based ST Freq	Distribution Chi- Squared TS Value	MTD Chi- Squared TS	Level of Significance
<u>Learning MTD</u>					
BLACKBOARD	4	5.01	0.2052	0.2407	NA
CASE STUDY	2	3.30	0.5135	0.5687	NA
COMPUTER-ASSISTED INSTR	5	3.18	1.0418	1.1493	NA
CONFER W/OTHER STUDENTS	3	3.06	0.0011	0.0012	NA
DEBATE	8	6.73	0.2411	0.3005	NA
DEMONSTRATION	0	0.24	0.2446	0.2464	NA
DISCUSS W/INSTRUCTOR	0	1.35	1.3453	1.4007	NA
DRILL AND REPETITION	11	9.17	0.3640	0.4985	NA
EXAMINATION	7	5.26	0.5764	0.6818	NA
EXERCISES	1	0.73	0.0966	0.0987	NA
FILMS/VIDEOTAPES	3	5.01	0.8092	0.9492	NA
FLIPCHARTS	6	5.26	0.1044	0.1235	NA
GAMES	3	5.87	1.4036	1.6965	NA
GROUP DISCUSSION	4	4.40	0.0369	0.0423	NA
GROUP PROJECTS	8	6.73	0.2411	0.3005	NA
GUEST LECTURER/SPEAKER	3	3.18	0.0102	0.0112	NA
HOMEWORK ASSIGNMENTS	3	2.20	0.2897	0.3097	NA
INDEPENDENT STUDY	5	3.18	1.0418	1.1493	NA
INTERVIEWS	1	3.67	1.9416	2.1765	NA
LABORATORY	2	2.94	0.2980	0.3262	NA
LECTURE	8	6.24	0.4981	0.6100	NA
MEMORIZATION	14	15.53	0.1512	0.2783	NA
OBSERVATION	1	1.22	0.0407	0.0422	NA
ORAL REPORTS	2	9.42	5.8420	8.0800	**
PEER TEACHING	4	8.44	2.3348	3.1057	NA
POP QUIZ	17	13.94	0.6705	1.1366	NA
PROGRAMMED INSTRUCTION	9	4.40	4.7999	5.5140	NA
READING	2	3.18	0.4378	0.4829	NA
ROLE PLAY	14	8.81	3.0639	4.1348	*
SIMULATIONS	2	1.59	0.1058	0.1110	NA
TERM PAPERS	8	7.95	0.0003	0.0004	NA
TUTORIAL	1	2.08	0.5601	0.5966	NA
VIEW GRAPHS	7	3.91	2.4339	2.7505	NA
WORKSHEETS	2	2.45	0.0813	0.0876	NA
TOTALS	170	169.63	31.8264		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable	NA

SF to NF: "Least Preferred"

	NF Observed Number of Times Selected	NF Expected Number Based SF Freq	Distrib- tion Chi- Squared TS Value	MTD Chi- Squared TS	Level of Significance
<u>Learning MTD</u>					
BLACKBOARD	4	5.48	0.4015	0.4787	NA
CASE STUDY	2	3.29	0.5060	0.5602	NA
COMPUTER-ASSISTED INSTR	5	4.39	0.0856	0.0983	NA
CONFER W/OTHER STUDENTS	3	2.74	0.0243	0.0264	NA
DEBATE	8	10.42	0.5618	0.8100	NA
DEMONSTRATION	0	1.10	1.0968	1.1333	NA
DISCUSS W/INSTRUCTOR	0	2.19	2.1935	2.3448	NA
DRILL AND REPETITION	11	9.32	0.3018	0.4158	NA
EXAMINATION	7	8.23	0.1827	0.2410	NA
EXERCISES	1	0.55	0.3719	0.3780	NA
FILMS/VIDEOTAPES	3	4.94	0.7590	0.8879	NA
FLIPCHARTS	6	5.48	0.0486	0.0579	NA
GAMES	3	2.19	0.2965	0.3169	NA
GROUP DISCUSSION	4	2.19	1.4877	1.5903	NA
GROUP PROJECTS	8	6.03	0.6419	0.7803	NA
GUEST LECTURER/SPEAKER	3	4.39	0.4386	0.5035	NA
HOMEWORK ASSIGNMENTS	3	2.74	0.0243	0.0264	NA
INDEPENDENT STUDY	5	2.19	3.5906	3.8382	NA
INTERVIEWS	1	4.94	3.1381	3.6710	NA
LABORATORY	2	1.65	0.0765	0.0804	NA
LECTURE	8	9.32	0.1876	0.2585	NA
MEMORIZATION	14	14.26	0.0047	0.0080	NA
OBSERVATION	1	0.55	0.3719	0.3780	NA
ORAL REPORTS	2	8.23	4.7121	6.2159	*
PEER TEACHING	4	8.23	2.1709	2.8637	NA
POP QUIZ	17	14.81	0.3250	0.5757	NA
PROGRAMMED INSTRUCTION	9	5.48	2.2545	2.6880	NA
READING	2	4.39	1.2989	1.4913	NA
ROLE PLAY	14	3.84	26.8975	30.3209	****
SIMULATIONS	2	1.10	0.7438	0.7686	NA
TERM PAPERS	8	8.23	0.0062	0.0082	NA
TUTORIAL	1	0.55	0.3719	0.3780	NA
VIEW GRAPHS	7	3.84	2.6034	2.9348	NA
WORKSHEETS	2	2.74	0.2008	0.2184	NA
TOTALS	170	170.00	58.3768		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable	NA

NT to SF: "Least Preferred"

	SF Observed Number of Times Selected	SF Expected Number Based NT Freq	Distribution Chi- Squared TS Value	MTD Chi- Squared TS	Level of Significance
<u>Learning MTD</u>					
BLACKBOARD	10	9.20	0.0696	0.0817	NA
CASE STUDY	6	3.60	1.6000	1.6986	NA
COMPUTER-ASSISTED INSTR	8	6.40	0.4000	0.4460	NA
CONFER W/OTHER STUDENTS	5	5.20	0.0077	0.0084	NA
DEBATE	19	4.00	56.2500	60.1293	****
DEMONSTRATION	2	0.00	0.0000	0.0645	NA
DISCUSS W/INSTRUCTOR	4	2.00	2.0000	2.0667	NA
DRILL AND REPETITION	17	24.00	2.0417	3.3311	NA
EXAMINATION	15	10.80	1.6333	1.9779	NA
EXERCISES	1	2.80	1.1571	1.2119	NA
FILMS/VIDEOTAPES	9	6.00	1.5000	1.6607	NA
FLIPCHARTS	10	12.40	0.4645	0.5806	NA
GAMES	4	12.00	5.3333	6.6133	NA
GROUP DISCUSSION	4	6.40	0.9000	1.0036	NA
GROUP PROJECTS	11	10.80	0.0037	0.0045	NA
GUEST LECTURER/SPEAKER	8	4.40	2.9455	3.1705	NA
HOMEWORK ASSIGNMENTS	5	5.60	0.0643	0.0707	NA
INDEPENDENT STUDY	4	6.00	0.6667	0.7381	NA
INTERVIEWS	9	6.00	1.5000	1.6607	NA
LABORATORY	3	2.40	0.1500	0.1560	NA
LECTURE	17	12.40	1.7065	2.1331	NA
MEMORIZATION	26	33.20	1.5614	3.3614	NA
OBSERVATION	1	2.40	0.8167	0.8496	NA
ORAL REPORTS	15	11.60	0.9966	1.2259	NA
PEER TEACHING	15	11.20	1.2893	1.5735	NA
POP QUIZ	27	27.20	0.0015	0.0026	NA
PROGRAMMED INSTRUCTION	10	12.80	0.6125	0.7718	NA
READING	8	4.80	2.1333	2.3124	NA
ROLE PLAY	7	15.60	4.7410	6.3350	*
SIMULATIONS	2	3.60	0.7111	0.7549	NA
TERM PAPERS	15	15.20	0.0026	0.0035	NA
TUTORIAL	1	4.80	3.0083	3.2608	NA
VIEW GRAPHS	7	10.00	0.9000	1.0731	NA
WORKSHEETS	5	4.00	0.2500	0.2672	NA
TOTALS	310	308.80	97.4182		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable	NA

NT to NF: "Least Preferred"

	NF Observed Number of Times Selected	NF Expected Number Based NT Freq	Distri- bution Chi- Squared TS Value	MTD Chi- Squared TS	Level of Significance
<u>Learning MTD</u>					
BLACKBOARD	4	5.05	0.2165	0.2542	NA
CASE STUDY	2	1.97	0.0003	0.0004	NA
COMPUTER-ASSISTED INSTR	5	3.51	0.6328	0.7057	NA
CONFER W/OTHER STUDENTS	3	2.85	0.0077	0.0084	NA
DEBATE	8	2.19	15.3700	16.4300	NA
DEMONSTRATION	0	0.00	0.0000	0.0000	NA
DISCUSS W/INSTRUCTOR	0	1.10	1.0968	1.1333	NA
DRILL AND REPETITION	11	13.16	0.3549	0.5791	NA
EXAMINATION	7	5.92	0.1960	0.2373	NA
EXERCISES	1	1.54	0.1867	0.1956	NA
FILMS/VIDEOTAPES	3	3.29	0.0256	0.0284	NA
FLIPCHARTS	6	6.80	0.0941	0.1176	NA
GAMES	3	6.58	1.9483	2.4159	NA
GROUP DISCUSSION	4	3.51	0.0685	0.0764	NA
GROUP PROJECTS	8	5.92	0.7287	0.8824	NA
GUEST LECTURER/SPEAKER	3	2.41	0.1428	0.1538	NA
HOMEWORK ASSIGNMENTS	3	3.07	0.0016	0.0018	NA
INDEPENDENT STUDY	5	3.29	0.8884	0.9835	NA
INTERVIEWS	1	3.29	1.5942	1.7651	NA
LABORATORY	2	1.32	0.3553	0.3697	NA
LECTURE	8	6.80	0.2118	0.2647	NA
MEMORIZATION	14	18.21	0.9719	2.0922	NA
OBSERVATION	1	1.32	0.0759	0.0790	NA
ORAL REPORTS	2	6.36	2.9901	3.6783	NA
PEER TEACHING	4	6.14	0.7470	0.9117	NA
POP QUIZ	17	14.92	0.2911	0.5187	NA
PROGRAMMED INSTRUCTION	9	7.02	0.5589	0.7043	NA
READING	2	2.63	0.1519	0.1646	NA
ROLE PLAY	14	8.55	3.4658	4.6311	*
SIMULATIONS	2	1.97	0.0003	0.0004	NA
TERM PAPERS	8	8.34	0.0135	0.0179	NA
TUTORIAL	1	2.63	1.0122	1.0971	NA
VIEW GRAPHS	7	5.48	0.4192	0.4998	NA
WORKSHEETS	2	2.19	0.0171	0.0183	NA
TOTALS	170	169.34	34.8361		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
Not Applicable	NA

**Appendix F: Calculations and Results for Chi-Squared Analyses to Isolate
Post-Test Learning MTD Preferences**

Total Sample: "Most Preferred"

<u>Learning MTD</u>	<u>Observed Number of Times Selected</u>	<u>Expected Number of Times Selected</u>	<u>Chi-Squared Test Statistic</u>	<u>Level of Significance</u>
BLACKBOARD	49	77.79	12.4952	NA
CASE STUDY	192	77.79	196.5672	****
COMPUTER-ASSISTED INSTR	87	77.79	1.2772	NA
CONFER W/OTHER STUDENTS	218	77.79	296.2556	****
DEBATE	70	77.79	0.9155	NA
DEMONSTRATION	140	77.79	58.3173	****
DISCUSS W/INSTRUCTOR	202	77.79	232.4976	****
DRILL AND REPITITION	9	77.79	71.3242	NA
EXAMINATION	29	77.79	35.8814	NA
EXERCISES	74	77.79	0.2169	NA
FILMS/VIDEOTAPES	47	77.79	14.2912	NA
FLIPCHARTS	7	77.79	75.5316	NA
GAMES	51	77.79	10.8196	NA
GROUP DISCUSSION	271	77.79	562.5678	****
GROUP PROJECTS	152	77.79	82.9871	****
GUEST LECTURER/SPEAKER	107	77.79	12.8551	***
HOMEWORK ASSIGNMENTS	136	77.79	51.0585	****
INDEPENDENT STUDY	120	77.79	26.8460	****
INTERVIEWS	17	77.79	55.7003	NA
LABORATORY	54	77.79	8.5324	NA
LECTURE	136	77.79	51.0585	****
MEMORIZATION	19	77.79	52.0957	NA
OBSERVATION	49	77.79	12.4952	NA
ORAL REPORTS	21	77.79	48.6117	NA
PEER TEACHING	48	77.79	13.3781	NA
POP QUIZ	5	77.79	79.8595	NA
PROGRAMMED INSTRUCTION	6	77.79	77.6805	NA
READING	94	77.79	3.9580	*
ROLE PLAY	21	77.79	48.6117	NA
SIMULATIONS	86	77.79	1.0148	NA
TERM PAPERS	48	77.79	13.3781	NA
TUTORIAL	13	77.79	63.2711	NA
VIEW GRAPHS	38	77.79	23.8656	NA
WORKSHEETS	15	77.79	59.4254	NA
TOTALS*	2631	2645.00		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

* The observed total does not equal the expected total because not all sample members used all five of their selections.

ST: "Most Preferred"

<u>Learning MTD</u>	<u>Observed Number of Times Selected</u>	<u>Expected Number of Times Selected</u>	<u>Chi-Squared Test Statistic</u>	<u>Level of Significance</u>
BLACKBOARD	30	42.21	4.1385	NA
CASE STUDY	96	42.21	80.3855	****
COMPUTER-ASSISTED INSTR	52	42.21	2.6646	NA
CONFER W/OTHER STUDENTS	112	42.21	135.3149	****
DEBATE	34	42.21	1.8705	NA
DEMONSTRATION	84	42.21	48.5220	****
DISCUSS W/INSTRUCTOR	115	42.21	147.1975	****
DRILL AND REPITITION	7	42.21	34.4301	NA
EXAMINATION	17	42.21	17.6487	NA
EXERCISES	37	42.21	0.7528	NA
FILMS/VIDEOTAPES	29	42.21	4.8444	NA
FLIPCHARTS	3	42.21	42.6983	NA
GAMES	30	42.21	4.1385	NA
GROUP DISCUSSION	154	42.21	347.1729	****
GROUP PROJECTS	69	42.21	19.9428	****
GUEST LECTURER/SPEAKER	62	42.21	10.8838	***
HOMEWORK ASSIGNMENTS	77	42.21	33.6294	****
INDEPENDENT STUDY	57	42.21	6.0798	*
INTERVIEWS	3	42.21	42.6983	NA
LABORATORY	29	42.21	4.8444	NA
LECTURE	78	42.21	35.5903	****
MEMORIZATION	10	42.21	28.8123	NA
OBSERVATION	21	42.21	12.4917	NA
ORAL REPORTS	13	42.21	23.6946	NA
PEER TEACHING	24	42.21	9.2073	NA
POP QUIZ	4	42.21	40.5479	NA
PROGRAMMED INSTRUCTION	3	42.21	42.6983	NA
READING	45	42.21	0.2169	NA
ROLE PLAY	14	42.21	22.0997	NA
SIMULATIONS	49	42.21	1.2823	NA
TERM PAPERS	27	42.21	6.4229	NA
TUTORIAL	7	42.21	34.4301	NA
VIEW GRAPHS	22	42.21	11.3413	NA
WORKSHEETS	10	42.21	28.8123	NA
TOTALS*	1424	1435.00		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

* The observed total does not equal the expected total because not all sample members used all five of their selections.

SF: "Most Preferred"

	Observed Number of Times <u>Selected</u>	Expected Number of Times Selected	Chi-Squared Test Statistic	Level of Significance
<u>Learning MTD</u>				
BLACKBOARD	3	6.32	2.0480	NA
CASE STUDY	11	6.32	4.0547	*
COMPUTER-ASSISTED INSTR	7	6.32	0.0848	NA
CONFER W/OTHER STUDENTS	25	6.32	64.6712	****
DEBATE	4	6.32	1.0010	NA
DEMONSTRATION	10	6.32	2.5060	NA
DISCUSS W/INSTRUCTOR	17	6.32	21.1338	****
DRILL AND REPETITION	0	6.32	7.4138	NA
EXAMINATION	3	6.32	2.0480	NA
EXERCISES	10	6.32	2.5060	NA
FILMS/VIDEOTAPES	5	6.32	0.3248	NA
FLIPCHARTS	0	6.32	7.4138	NA
GAMES	5	6.32	0.3248	NA
GROUP DISCUSSION	21	6.32	39.9360	****
GROUP PROJECTS	15	6.32	13.9575	***
GUEST LECTURER/SPEAKER	6	6.32	0.0194	NA
HOMEWORK ASSIGNMENTS	8	6.32	0.5211	NA
INDEPENDENT STUDY	5	6.32	0.3248	NA
INTERVIEWS	1	6.32	5.2544	NA
LABORATORY	5	6.32	0.3248	NA
LECTURE	14	6.32	10.9256	***
MEMORIZATION	4	6.32	1.0010	NA
OBSERVATION	5	6.32	0.3248	NA
ORAL REPORTS	0	6.32	7.4138	NA
PEER TEACHING	2	6.32	3.4658	NA
POP QUIZ	0	6.32	7.4138	NA
PROGRAMMED INSTRUCTION	1	6.32	5.2544	NA
READING	10	6.32	2.5060	NA
ROLE PLAY	2	6.32	3.4658	NA
SIMULATIONS	6	6.32	0.0194	NA
TERM PAPERS	3	6.32	2.0480	NA
TUTORIAL	0	6.32	7.4138	NA
VIEW GRAPHS	5	6.32	0.3248	NA
WORKSHEETS	2	6.32	3.4658	NA
TOTALS	215	215.00		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

NT: "Most Preferred"

	Observed Number of Times Selected	Expected Number of Times Selected	Chi-Squared Test Statistic	Level of Significance
<u>Learning MTD</u>				
BLACKBOARD	11	21.91	6.3708	NA
CASE STUDY	60	21.91	77.6221	****
COMPUTER-ASSISTED INSTR	27	21.91	1.3853	NA
CONFER W/OTHER STUDENTS	59	21.91	73.5997	****
DEBATE	29	21.91	2.6883	NA
DEMONSTRATION	36	21.91	10.6198	**
DISCUSS W/INSTRUCTOR	56	21.91	62.1745	****
DRILL AND REPITITION	2	21.91	21.2140	NA
EXAMINATION	6	21.91	13.5469	NA
EXERCISES	14	21.91	3.3493	NA
FILMS/VIDEOTAPES	9	21.91	8.9202	NA
FLIPCHARTS	1	21.91	23.3983	NA
GAMES	11	21.91	6.3708	NA
GROUP DISCUSSION	78	21.91	168.3244	****
GROUP PROJECTS	49	21.91	39.2613	****
GUEST LECTURER/SPEAKER	31	21.91	4.4194	*
HOMEWORK ASSIGNMENTS	43	21.91	23.7949	****
INDEPENDENT STUDY	42	21.91	21.5917	****
INTERVIEWS	9	21.91	8.9202	NA
LABORATORY	12	21.91	5.2566	NA
LECTURE	31	21.91	4.4194	*
MEMORIZATION	4	21.91	17.1664	NA
OBSERVATION	18	21.91	0.8187	NA
ORAL REPORTS	6	21.91	13.5469	NA
PEER TEACHING	14	21.91	3.3493	NA
POP QUIZ	1	21.91	23.3983	NA
PROGRAMMED INSTRUCTION	2	21.91	21.2140	NA
READING	28	21.91	1.9833	NA
ROLE PLAY	5	21.91	15.3032	NA
SIMULATIONS	25	21.91	0.5103	NA
TERM PAPERS	12	21.91	5.2566	NA
TUTORIAL	5	21.91	15.3032	NA
VIEW GRAPHS	6	21.91	13.5469	NA
WORKSHEETS	1	21.91	23.3983	NA
TOTALS*	743	745.00		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

* The observed total does not equal the expected total because not all sample members used all five of their selections.

NF: "Most Preferred"

<u>Learning MTD</u>	<u>Observed Number of Times Selected</u>	<u>Expected Number of Times Selected</u>	<u>Chi-Squared Test Statistic</u>	<u>Level of Significance</u>
BLACKBOARD	5	7.35	0.8828	NA
CASE STUDY	25	7.35	49.6552	****
COMPUTER-ASSISTED INSTR	1	7.35	6.4353	NA
CONFER W/OTHER STUDENTS	22	7.35	34.2074	****
DEBATE	3	7.35	3.0212	NA
DEMONSTRATION	10	7.35	1.1172	NA
DISCUSS W/INSTRUCTOR	14	7.35	7.0450	**
DRILL AND REPITITION	0	7.35	8.6207	NA
EXAMINATION	3	7.35	3.0212	NA
EXERCISES	13	7.35	5.0847	*
FILMS/VIDEOTAPES	4	7.35	1.7926	NA
FLIPCHARTS	3	7.35	3.0212	NA
GAMES	5	7.35	0.8828	NA
GROUP DISCUSSION	18	7.35	18.0750	****
GROUP PROJECTS	19	7.35	21.6298	****
GUEST LECTURER/SPEAKER	8	7.35	0.0668	NA
HOMEWORK ASSIGNMENTS	8	7.35	0.0668	NA
INDEPENDENT STUDY	16	7.35	11.9222	***
INTERVIEWS	4	7.35	1.7926	NA
LABORATORY	8	7.35	0.0668	NA
LECTURE	13	7.35	5.0847	*
MEMORIZATION	1	7.35	6.4353	NA
OBSERVATION	5	7.35	0.8828	NA
ORAL REPORTS	2	7.35	4.5688	NA
PEER TEACHING	8	7.35	0.0668	NA
POP QUIZ	0	7.35	8.6207	NA
PROGRAMMED INSTRUCTION	0	7.35	8.6207	NA
READING	11	7.35	2.1208	NA
ROLE PLAY	0	7.35	8.6207	NA
SIMULATIONS	6	7.35	0.2919	NA
TERM PAPERS	6	7.35	0.2919	NA
TUTORIAL	1	7.35	6.4353	NA
VIEW GRAPHS	5	7.35	0.8828	NA
WORKSHEETS	2	7.35	4.5688	NA
TOTALS*	249	250.00		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

* The observed total does not equal the expected total because not all sample members used all five of their selections.

Total Sample: "Least Preferred"

<u>Learning MTD</u>	<u>Observed Number of Times Selected</u>	<u>Expected Number of Times Selected</u>	<u>Chi-Squared Test Statistic</u>	<u>Level of Significance</u>
BLACKBOARD	92	77.79	3.0414	NA
CASE STUDY	105	77.79	11.1547	***
COMPUTER-ASSISTED INSTR	63	77.79	3.2985	NA
CONFER W/OTHER STUDENTS	18	77.79	53.8829	NA
DEBATE	41	77.79	20.4029	NA
DEMONSTRATION	11	77.79	67.2374	NA
DISCUSS W/INSTRUCTOR	28	77.79	37.3672	NA
DRILL AND REPITITION	153	77.79	85.2389	****
EXAMINATION	208	77.79	255.5026	****
EXERCISES	21	77.79	48.6117	NA
FILMS/VIDEOTAPES	60	77.79	4.7719	NA
FLIPCHARTS	45	77.79	16.2079	NA
GAMES	50	77.79	11.6423	NA
GROUP DISCUSSION	49	77.79	12.4952	NA
GROUP PROJECTS	130	77.79	41.0746	****
GUEST LECTURER/SPEAKER	66	77.79	2.0964	NA
HOMEWORK ASSIGNMENTS	68	77.79	1.4457	NA
INDEPENDENT STUDY	33	77.79	30.2396	NA
INTERVIEWS	26	77.79	40.4292	NA
LABORATORY	44	77.79	17.2114	NA
LECTURE	112	77.79	17.6334	****
MEMORIZATION	277	77.79	598.0514	****
OBSERVATION	9	77.79	71.3242	NA
ORAL REPORTS	105	77.79	11.1547	***
PEER TEACHING	117	77.79	23.1652	****
POP QUIZ	173	77.79	136.6035	****
PROGRAMMED INSTRUCTION	81	77.79	0.1549	NA
READING	64	77.79	2.8676	NA
ROLE PLAY	69	77.79	1.1655	NA
SIMULATIONS	29	77.79	35.8814	NA
TERM PAPERS	173	77.79	136.6035	****
TUTORIAL	32	77.79	31.6048	NA
VIEW GRAPHS	40	77.79	21.5270	NA
WORKSHEETS	23	77.79	45.2483	NA
TOTALS*	2615	2645.00		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

* The observed total does not equal the expected total because not all sample members used all five of their selections.

ST: "Least Preferred"

	Observed Number of Times Selected	Expected Number of Times Selected	Chi-Squared Test Statistic	Level of Significance
<u>Learning MTD</u>				
BLACKBOARD	47	42.21	0.6384	NA
CASE STUDY	53	42.21	3.2365	NA
COMPUTER-ASSISTED INSTR	30	42.21	4.1385	NA
CONFER W/OTHER STUDENTS	11	42.21	27.0508	NA
DEBATE	27	42.21	6.4229	NA
DEMONSTRATION	6	42.21	36.4138	NA
DISCUSS W/INSTRUCTOR	12	42.21	25.3449	NA
DRILL AND REPITITION	80	42.21	39.6786	****
EXAMINATION	104	42.21	106.0724	****
EXERCISES	15	42.21	20.5605	NA
FILMS/VIDEOTAPES	33	42.21	2.3542	NA
FLIPCHARTS	24	42.21	9.2073	NA
GAMES	24	42.21	9.2073	NA
GROUP DISCUSSION	30	42.21	4.1385	NA
GROUP PROJECTS	82	42.21	43.9892	****
GUEST LECTURER/SPEAKER	36	42.21	1.0698	NA
HOMEWORK ASSIGNMENTS	39	42.21	0.2855	NA
INDEPENDENT STUDY	16	42.21	19.0768	NA
INTERVIEWS	19	42.21	14.9591	NA
LABORATORY	22	42.21	11.3413	NA
LECTURE	54	42.21	3.8640	*
MEMORIZATION	150	42.21	322.7736	****
OBSERVATION	3	42.21	42.6983	NA
ORAL REPORTS	60	42.21	8.7955	**
PEER TEACHING	70	42.21	21.4592	****
POP QUIZ	91	42.21	66.1368	****
PROGRAMMED INSTRUCTION	43	42.21	0.0175	NA
READING	33	42.21	2.3542	NA
ROLE PLAY	36	42.21	1.0698	NA
SIMULATIONS	14	42.21	22.0997	NA
TERM PAPERS	108	42.21	120.2492	****
TUTORIAL	14	42.21	22.0997	NA
VIEW GRAPHS	24	42.21	9.2073	NA
WORKSHEETS	11	42.21	27.0508	NA
TOTALS*	1421	1435.00		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

* The observed total does not equal the expected total because not all sample members used all five of their selections.

SP: "Least Preferred"

	Observed Number of Times Selected	Expected Number of Times Selected	Chi-Squared Test Statistic	Level of Significance
<u>Learning MTD</u>				
BLACKBOARD	7	6.32	0.0848	NA
CASE STUDY	11	6.32	4.0547	*
COMPUTER-ASSISTED INSTR	7	6.32	0.0848	NA
CONFER W/OTHER STUDENTS	2	6.32	3.4658	NA
DEBATE	5	6.32	0.3248	NA
DEMONSTRATION	2	6.32	3.4658	NA
DISCUSS W/INSTRUCTOR	2	6.32	3.4658	NA
DRILL AND REPITITION	7	6.32	0.0848	NA
EXAMINATION	18	6.32	25.2781	****
EXERCISES	2	6.32	3.4658	NA
FILMS/VIDEOTAPES	6	6.32	0.0194	NA
FLIPCHARTS	5	6.32	0.3248	NA
GAMES	4	6.32	1.0010	NA
GROUP DISCUSSION	3	6.32	2.0480	NA
GROUP PROJECTS	7	6.32	0.0848	NA
GUEST LECTURER/SPEAKER	4	6.32	1.0010	NA
HOMEWORK ASSIGNMENTS	5	6.32	0.3248	NA
INDEPENDENT STUDY	4	6.32	1.0010	NA
INTERVIEWS	1	6.32	5.2544	NA
LABORATORY	4	6.32	1.0010	NA
LECTURE	8	6.32	0.5211	NA
MEMORIZATION	17	6.32	21.1338	****
OBSERVATION	0	6.32	7.4138	NA
ORAL REPORTS	11	6.32	4.0547	*
PEER TEACHING	7	6.32	0.0848	NA
POP QUIZ	15	6.32	13.9575	***
PROGRAMMED INSTRUCTION	4	6.32	1.0010	NA
READING	9	6.32	1.3281	NA
ROLE PLAY	5	6.32	0.3248	NA
SIMULATIONS	3	6.32	2.0480	NA
TERM PAPERS	20	6.32	34.6792	****
TUTORIAL	3	6.32	2.0480	NA
VIEW GRAPHS	3	6.32	2.0480	NA
WORKSHEETS	2	6.32	3.4658	NA
TOTALS*	213	215.00		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

* The observed total does not equal the expected total because not all sample members used all five of their selections.

NT: "Least Preferred"

	Observed Number of Times Selected	Expected Number of Times Selected	Chi-Squared Test Statistic	Level of Significance
<u>Learning MTD</u>				
BLACKBOARD	27	21.91	1.3853	NA
CASE STUDY	34	21.91	7.8186	**
COMPUTER-ASSISTED INSTR	19	21.91	0.4536	NA
CONFER W/OTHER STUDENTS	3	21.91	19.1367	NA
DEBATE	7	21.91	11.8977	NA
DEMONSTRATION	1	21.91	23.3983	NA
DISCUSS W/INSTRUCTOR	9	21.91	8.9202	NA
DRILL AND REPITITION	47	21.91	33.6778	****
EXAMINATION	59	21.91	73.5997	****
EXERCISES	3	21.91	19.1367	NA
FILMS/VIDEOTAPES	17	21.91	1.2909	NA
FLIPCHARTS	13	21.91	4.2494	NA
GAMES	14	21.91	3.3493	NA
GROUP DISCUSSION	12	21.91	5.2566	NA
GROUP PROJECTS	28	21.91	1.9833	NA
GUEST LECTURER/SPEAKER	19	21.91	0.4536	NA
HOMEWORK ASSIGNMENTS	17	21.91	1.2909	NA
INDEPENDENT STUDY	10	21.91	7.5920	NA
INTERVIEWS	5	21.91	15.3032	NA
LABORATORY	12	21.91	5.2566	NA
LECTURE	36	21.91	10.6198	**
MEMORIZATION	82	21.91	193.1890	****
OBSERVATION	5	21.91	15.3032	NA
ORAL REPORTS	26	21.91	0.8943	NA
PEER TEACHING	30	21.91	3.5003	NA
POP QUIZ	51	21.91	45.2729	****
PROGRAMMED INSTRUCTION	28	21.91	1.9833	NA
READING	18	21.91	0.8187	NA
ROLE PLAY	25	21.91	0.5103	NA
SIMULATIONS	8	21.91	10.3554	NA
TERM PAPERS	38	21.91	13.8491	***
TUTORIAL	12	21.91	5.2566	NA
VIEW GRAPHS	10	21.91	7.5920	NA
WORKSHEETS	10	21.91	7.5920	NA
TOTALS*	735	745.00		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

* The observed total does not equal the expected total because not all sample members used all five of their selections.

NF: "Least Preferred"

	Observed Number of Times Selected	Expected Number of Times Selected	Chi-Squared Test Statistic	Level of Significance
<u>Learning MTD</u>				
BLACKBOARD	11	7.35	2.1208	NA
CASE STUDY	7	7.35	0.0199	NA
COMPUTER-ASSISTED INSTR	7	7.35	0.0199	NA
CONFER W/OTHER STUDENTS	2	7.35	4.5688	NA
DEBATE	2	7.35	4.5688	NA
DEMONSTRATION	2	7.35	4.5688	NA
DISCUSS W/INSTRUCTOR	5	7.35	0.8828	NA
DRILL AND REPITITION	19	7.35	21.6298	****
EXAMINATION	27	7.35	61.5481	****
EXERCISES	1	7.35	6.4353	NA
FILMS/VIDEOTAPES	4	7.35	1.7926	NA
FLIPCHARTS	3	7.35	3.0212	NA
GAMES	8	7.35	0.0668	NA
GROUP DISCUSSION	4	7.35	1.7926	NA
GROUP PROJECTS	13	7.35	5.0847	*
GUEST LECTURER/SPEAKER	7	7.35	0.0199	NA
HOMEWORK ASSIGNMENTS	7	7.35	0.0199	NA
INDEPENDENT STUDY	3	7.35	3.0212	NA
INTERVIEWS	1	7.35	6.4353	NA
LABORATORY	6	7.35	0.2919	NA
LECTURE	14	7.35	7.0450	**
MEMORIZATION	28	7.35	67.9730	****
OBSERVATION	1	7.35	6.4353	NA
ORAL REPORTS	8	7.35	0.0668	NA
PEER TEACHING	10	7.35	1.1172	NA
POP QUIZ	16	7.35	11.9222	***
PROGRAMMED INSTRUCTION	6	7.35	0.2919	NA
READING	4	7.35	1.7926	NA
ROLE PLAY	3	7.35	3.0212	NA
SIMULATIONS	4	7.35	1.7926	NA
TERM PAPERS	7	7.35	0.0199	NA
TUTORIAL	3	7.35	3.0212	NA
VIEW GRAPHS	3	7.35	3.0212	NA
WORKSHEETS	0	7.35	8.6207	NA
TOTALS*	246	250.00		

<u>Level of Significance</u>	<u>Symbol</u>
p < .05	*
P < .01	**
P < .001	***
P < .0001	****
Not Applicable	NA

* The observed total does not equal the expected total because not all sample members used all five of their selections.

Appendix G: Calculations and Results for Chi-Squared Analyses Comparing
the Sample Post-Test Learning MTD Preference Distributions to Those of
the Pre-Test and Isolating Significantly Different Learning MTDs

Total Sample: "Most Preferred"

LEARNING MTD	POST-TEST	EXPECTED	DISTRIBUTION CHI-SQUARED	MTD CHI-SQUARED TEST	LEVEL OF SIGNIFICANCE
	OBSERVED NUMBER OF TIMES SELECTED	NUMBER BASED ON PRE-TEST REL FREQ			
BLACKBOARD	49	58.69	1.5992	1.7999	NA
CASE STUDY	192	120.36	42.6419	55.2881	****
COMPUTER-ASSISTED INSTR	87	65.65	6.9427	7.9324	NA
CONFER W/OTHER STUDENTS	218	127.32	64.5794	85.1933	****
DEBATE	70	73.61	0.1769	0.2056	NA
DEMONSTRATION	140	251.66	49.5435	94.9583	****
DISCUSS W/INSTRUCTOR	202	189.99	0.7593	1.1884	NA
DRILL AND REPETITION	9	41.78	25.7165	27.9344	NA
EXAMINATION	29	28.85	0.0008	0.0009	NA
EXERCISES	74	124.34	20.3795	26.6850	****
FILMS/VIDEOTAPES	47	66.65	5.7910	6.6308	NA
FLIPCHARTS	7	1.99	12.6198	12.6677	NA
GAMES	51	58.69	1.0070	1.1335	NA
GROUP DISCUSSION	271	203.91	22.0700	36.0341	****
GROUP PROJECTS	152	95.49	33.4392	40.8529	****
GUEST LECTURER/SPEAKER	107	114.39	0.4776	0.6102	NA
HOMEWORK ASSIGNMENTS	136	104.44	9.5340	11.8950	***
INDEPENDENT STUDY	120	95.49	6.2900	7.6846	**
INTERVIEWS	17	10.94	3.3543	3.4255	NA
LABORATORY	54	105.44	25.0948	31.3833	****
LECTURE	136	111.41	5.4288	6.8869	**
MEMORIZATION	19	21.88	0.3800	0.3964	NA
OBSERVATION	49	101.46	27.1246	33.6040	****
ORAL REPORTS	21	14.92	2.4770	2.5493	NA
PEER TEACHING	48	32.83	7.0150	7.4818	NA
POP QUIZ	5	6.96	0.5534	0.5608	NA
PROGRAMMED INSTRUCTION	6	28.85	18.0945	19.1440	NA
READING	94	105.44	1.2410	1.5520	NA
ROLE PLAY	21	60.68	25.9451	29.3268	NA
SIMULATIONS	86	111.41	5.7943	7.3505	**
TERM PAPERS	48	19.89	39.7071	41.2673	NA
TUTORIAL	13	25.86	6.3970	6.7276	NA
VIEW GRAPHS	38	21.88	11.8692	12.3842	NA
WORKSHEETS	15	25.86	4.5623	4.7981	NA
TOTALS*	2631	2629.01	488.6065		

LEVEL OF SIGNIFICANCE	SYMBOL
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
NOT APPLICABLE	NA

* Differences between observed and expected totals are due to rounding.

ST: "Most Preferred"

	POST-TEST OBSERVED NUMBER OF TIMES SELECTED	EXPECTED NUMBER BASED ON PRE-TEST REL FREQ	DISTRI- BUTION CHI- SQUARED TS VALUE	MTD CHI- SQUARED TEST STATISTIC	LEVEL OF SIGNIFI- CANCE
<u>LEARNING MTD</u>					
BLACKBOARD	30	40.98	2.9412	3.4355	NA
CASE STUDY	96	63.52	16.6126	21.3810	****
COMPUTER-ASSISTED INSTR	52	39.95	3.6319	4.2245	NA
CONFER W/OTHER STUDENTS	112	66.59	30.9668	40.4167	****
DEBATE	34	34.83	0.0199	0.0226	NA
DEMONSTRATION	84	136.25	20.0392	38.4199	****
DISCUSS W/INSTRUCTOR	115	102.45	1.5384	2.4027	NA
DRILL AND REPITITION	7	27.66	15.4319	17.0919	NA
EXAMINATION	17	19.46	0.3121	0.3350	NA
EXERCISES	37	85.03	27.1304	38.6782	****
FILMS/VIDEOTAPES	29	34.83	0.9764	1.1124	NA
FLIPCHARTS	3	2.05	0.4415	0.4447	NA
GAMES	30	29.71	0.0028	0.0032	NA
GROUP DISCUSSION	154	102.45	25.9435	40.5185	****
GROUP PROJECTS	69	51.22	6.1695	7.5225	**
GUEST LECTURER/SPEAKER	62	62.49	0.0039	0.0050	NA
HOMEWORK ASSIGNMENTS	77	68.64	1.0185	1.3419	NA
INDEPENDENT STUDY	57	46.10	2.5768	3.0745	NA
INTERVIEWS	3	4.10	0.2941	0.2984	NA
LABORATORY	29	56.35	13.2711	16.5443	****
LECTURE	78	58.39	6.5826	8.2804	**
MEMORIZATION	10	12.29	0.4279	0.4472	NA
OBSERVATION	21	48.15	15.3086	18.4233	NA
ORAL REPORTS	13	7.17	4.7376	4.8600	NA
PEER TEACHING	24	14.34	6.5030	6.8478	NA
POP QUIZ	4	4.10	0.0023	0.0024	NA
PROGRAMMED INSTRUCTION	3	14.34	8.9700	9.4456	NA
READING	45	53.27	1.2844	1.5800	NA
ROLE PLAY	14	25.61	5.2643	5.7845	NA
SIMULATIONS	49	62.49	2.9130	3.7318	NA
TERM PAPERS	27	7.17	54.8275	56.2437	NA
TUTORIAL	7	14.34	3.7589	3.9582	NA
VIEW GRAPHS	22	12.29	7.6638	8.0096	NA
WORKSHEETS	10	15.37	1.8744	1.9813	NA
TOTALS	1424	1424.00	289.4407		

<u>LEVEL OF SIGNIFICANCE</u>	<u>SYMBOL</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
NOT APPLICABLE	NA

SF: "Most Preferred"

	POST-TEST OBSERVED NUMBER OF TIMES SELECTED	EXPECTED NUMBER BASED ON PRE-TEST REL FREQ	DISTRIBU- TION CHI- SQUARED TS VALUE	MTD CHI- SQUARED TEST STATISTIC	LEVEL OF SIGNIFI- CANCE
<u>LEARNING MTD</u>					
BLACKBOARD	3	4.16	0.3241	0.3588	NA
CASE STUDY	11	9.02	0.4365	0.5523	NA
COMPUTER-ASSISTED INSTR	7	5.55	0.3798	0.4360	NA
CONFER W/OTHER STUDENTS	25	12.48	12.5485	17.6819	****
DEBATE	4	5.55	0.4321	0.4961	NA
DEMONSTRATION	10	21.50	6.1512	12.3023	***
DISCUSS W/INSTRUCTOR	17	15.95	0.0689	0.1095	NA
DRILL AND REPETITION	0	3.47	3.4677	3.7719	NA
EXAMINATION	3	2.08	0.4062	0.4269	NA
EXERCISES	10	8.32	0.3381	0.4192	NA
FILMS/VIDEOTAPES	5	8.32	1.3265	1.6448	NA
FLIPCHARTS	0	0.00	0.0000	0.0000	NA
GAMES	5	8.32	1.3265	1.6448	NA
GROUP DISCUSSION	21	13.87	3.6640	5.4087	*
GROUP PROJECTS	15	9.71	2.8824	3.7231	NA
GUEST LECTURER/SPEAKER	6	8.32	0.6482	0.8037	NA
HOMEWORK ASSIGNMENTS	8	6.94	0.1634	0.1948	NA
INDEPENDENT STUDY	5	6.24	0.2471	0.2891	NA
INTERVIEWS	1	0.69	0.1354	0.1376	NA
LABORATORY	5	5.55	0.0542	0.0622	NA
LECTURE	14	8.32	3.8730	4.8025	*
MEMORIZATION	4	0.69	15.7633	16.0217	NA
OBSERVATION	5	12.48	4.4865	6.3218	*
ORAL REPORTS	0	0.69	0.6935	0.7049	NA
PEER TEACHING	2	3.47	0.6212	0.6757	NA
POP QUIZ	0	0.69	0.6935	0.7049	NA
PROGRAMMED INSTRUCTION	1	4.16	2.4016	2.6589	NA
READING	10	6.24	2.2626	2.6468	NA
ROLE PLAY	2	4.16	1.1225	1.2428	NA
SIMULATIONS	6	7.63	0.3478	0.4229	NA
TERM PAPERS	3	2.08	0.4062	0.4259	NA
TUTORIAL	0	3.47	3.4677	3.7719	NA
VIEW GRAPHS	5	2.08	4.0961	4.3044	NA
WORKSHEETS	2	2.77	0.2161	0.2310	NA
TOTALS	215	215.00	75.4525		

<u>LEVEL OF SIGNIFICANCE</u>	<u>SYMBOL</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
NOT APPLICABLE	NA

NT: "Most Preferred"

	POST-TEST OBSERVED NUMBER OF TIMES SELECTED	EXPECTED NUMBER BASED ON PRE-TEST REL FREQ	DISTRI- BUTION CHI- SQUARED TS VALUE	MTD CHI- SQUARED TEST STATISTIC	LEVEL OF SIGNIFI- CANCE
<u>LEARNING MTD</u>					
BLACKBOARD	11	8.63	0.6519	0.6920	NA
CASE STUDY	60	32.60	23.0387	29.5124	****
COMPUTER-ASSISTED INSTR	27	16.30	7.0273	7.8930	NA
CONFER W/OTHER STUDENTS	59	35.47	15.6053	20.4985	****
DEBATE	29	28.76	0.0020	0.0025	NA
DEMONSTRATION	36	73.82	19.3767	38.5050	****
DISCUSS W/INSTRUCTOR	56	58.48	0.1053	0.1736	NA
DRILL AND REPITITION	2	5.75	2.4476	2.5462	NA
EXAMINATION	6	6.71	0.0753	0.0789	NA
EXERCISES	14	24.93	4.7896	5.7549	NA
FILMS/VIDEOTAPES	9	14.38	2.0132	2.2289	NA
FLIPCHARTS	1	0.00	0.0000	0.0067	NA
GAMES	11	12.46	0.1718	0.1875	NA
GROUP DISCUSSION	78	68.07	1.4491	2.6739	NA
GROUP PROJECTS	49	25.89	20.6410	24.9950	****
GUEST LECTURER/SPEAKER	31	30.68	0.0034	0.0042	NA
HOMEWORK ASSIGNMENTS	43	19.17	29.6059	33.9919	****
INDEPENDENT STUDY	42	32.60	2.7130	3.4753	NA
INTERVIEWS	9	3.83	6.9570	7.1413	NA
LABORATORY	12	35.47	15.5318	20.4019	****
LECTURE	31	31.64	0.0128	0.0163	NA
MEMORIZATION	4	3.83	0.0071	0.0073	NA
OBSERVATION	18	29.72	4.6217	5.7772	NA
ORAL REPORTS	6	5.75	0.0107	0.0111	NA
PEER TEACHING	14	12.46	0.1895	0.2068	NA
POP QUIZ	1	1.92	0.4390	0.4447	NA
PROGRAMMED INSTRUCTION	2	7.67	4.1912	4.4193	NA
READING	28	32.60	0.6481	0.8302	NA
ROLE PLAY	5	21.09	12.2769	14.3077	NA
SIMULATIONS	25	32.60	1.7702	2.2676	NA
TERM PAPERS	12	8.63	1.3175	1.3987	NA
TUTORIAL	5	6.71	0.4362	0.4568	NA
VIEW GRAPHS	6	6.71	0.0753	0.0789	NA
WORKSHEETS	1	5.75	3.9261	4.0842	NA
TOTALS*	743	741.08	182.1281		

<u>LEVEL OF SIGNIFICANCE</u>	<u>SYMBOL</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
NOT APPLICABLE	NA

* Differences between observed and expected totals are due to rounding.

NF: "Most Preferred"

	POST-TEST OBSERVED NUMBER OF TIMES SELECTED	EXPECTED NUMBER BASED ON PRE-TEST REL FREQ	DISTRIBU- TION CHI- SQUARED TS VALUE	MTD CHI- SQUARED TEST STATISTIC	LEVEL OF SIGNIFI- CANCE
<u>LEARNING MTD</u>					
BLACKBOARD	5	5.86	0.1259	0.1427	NA
CASE STUDY	25	17.58	3.1354	4.8456	*
COMPUTER-ASSISTED INSTR	1	2.93	1.2708	1.3502	NA
CONFER W/OTHER STUDENTS	22	11.72	9.0229	11.7991	***
DEBATE	3	2.93	0.0017	0.0018	NA
DEMONSTRATION	10	17.58	3.2659	5.0473	*
DISCUSS W/INSTRUCTOR	14	10.25	1.3694	1.7244	NA
DRILL AND REPETITION	0	5.86	5.8588	6.6400	NA
EXAMINATION	3	0.00	0.0000	0.1807	NA
EXERCISES	13	5.86	8.7042	9.8648	**
FILMS/VIDEOTAPES	4	8.79	2.6089	3.1679	NA
FLIPCHARTS	3	0.00	0.0000	0.1807	NA
GAMES	5	7.32	0.7372	0.8643	NA
GROUP DISCUSSION	18	20.51	0.3062	0.5206	NA
GROUP PROJECTS	19	7.32	18.6167	21.8265	****
GUEST LECTURER/SPEAKER	8	14.65	3.0165	4.2734	*
HOMEWORK ASSIGNMENTS	8	11.72	1.1795	1.5424	NA
INDEPENDENT STUDY	16	11.72	1.5650	2.0466	NA
INTERVIEWS	4	2.93	0.3913	0.4157	NA
LABORATORY	8	8.79	0.0707	0.0858	NA
LECTURE	13	14.65	0.1852	0.2624	NA
MEMORIZATION	1	7.32	5.4601	6.4015	NA
OBSERVATION	5	8.79	1.6329	1.9829	NA
ORAL REPORTS	2	1.46	0.1956	0.2016	NA
PEER TEACHING	8	1.46	29.1595	30.0431	NA
POP QUIZ	0	0.00	0.0000	0.0000	NA
PROGRAMMED INSTRUCTION	0	1.46	1.4647	1.5091	NA
READING	11	16.11	1.6218	2.3975	NA
ROLE PLAY	0	11.72	11.7176	15.3231	NA
SIMULATIONS	6	8.79	0.8846	1.0742	NA
TERM PAPERS	6	1.46	14.0430	14.4686	NA
TUTORIAL	1	0.00	0.0000	0.0201	NA
VIEW GRAPHS	5	0.00	0.0000	0.5020	NA
WORKSHEETS	2	1.46	0.1956	0.2016	NA
TOTALS	249	249.00	127.8077		

<u>LEVEL OF SIGNIFICANCE</u>	<u>SYMBOL</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
NOT APPLICABLE	NA

Total Sample: "Least Preferred"

	POST-TEST OBSERVED NUMBER OF TIMES SELECTED	EXPECTED NUMBER BASED ON PRE-TEST REL FREQ	DISTRIBU- TION CHI- SQUARED TS VALUE	MTD CHI- SQUARED TEST STATISTIC	LEVEL OF SIGNIFI- CANCE
<u>LEARNING MTD</u>					
BLACKBOARD	92	77.12	2.8730	3.3699	NA
CASE STUDY	105	43.50	86.9437	94.8314	****
COMPUTER-ASSISTED INSTR	63	54.38	1.3677	1.5264	NA
CONFER W/OTHER STUDENTS	18	45.48	16.6025	18.1837	NA
DEBATE	41	90.96	27.4379	33.2143	NA
DEMONSTRATION	11	3.95	12.5517	12.6473	NA
DISCUSS W/INSTRUCTOR	28	19.77	3.4229	3.5574	NA
DRILL AND REPITITION	153	161.15	0.4123	0.5959	NA
EXAMINATION	208	90.96	150.6124	182.3202	****
EXERCISES	21	14.83	2.5672	2.6421	NA
FILMS/VIDEOTAPES	60	67.23	0.7773	0.8919	NA
FLIPCHARTS	45	88.98	21.7373	26.1937	NA
GAMES	50	84.04	13.7851	16.4241	NA
GROUP DISCUSSION	49	59.32	1.7952	2.0249	NA
GROUP PROJECTS	130	99.85	9.1008	11.2484	***
GUEST LECTURER/SPEAKER	66	47.46	7.2467	7.9698	NA
HOMEWORK ASSIGNMENTS	68	39.55	20.4725	22.1472	NA
INDEPENDENT STUDY	33	49.43	5.4628	6.0330	NA
INTERVIEWS	26	54.38	14.8081	16.5263	NA
LABORATORY	44	34.60	2.5519	2.7327	NA
LECTURE	112	105.79	0.3650	0.4575	NA
MEMORIZATION	277	247.16	3.6015	6.8286	**
OBSERVATION	9	17.80	4.3475	4.5006	NA
ORAL REPORTS	105	121.60	2.2674	2.9543	NA
PEER TEACHING	117	114.68	0.0468	0.0599	NA
POP QUIZ	173	223.44	11.3851	19.8770	****
PROGRAMMED INSTRUCTION	81	86.01	0.2922	0.3497	NA
READING	64	47.46	5.7679	6.3435	NA
ROLE PLAY	69	130.50	28.9848	38.6221	****
SIMULATIONS	29	25.71	0.4223	0.4442	NA
TERM PAPERS	173	124.57	18.8277	24.7142	****
TUTORIAL	32	30.65	0.0596	0.0633	NA
VIEW GRAPHS	40	70.19	12.9884	15.0019	NA
WORKSHEETS	23	36.58	5.0417	5.4208	NA
TOTALS*	2615	2609.07	496.9266		

<u>LEVEL OF SIGNIFICANCE</u>	<u>SYMBOL</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
NOT APPLICABLE	NA

* Differences between observed and expected totals are due to rounding.

ST: "Least Preferred"

	POST-TEST OBSERVED NUMBER OF TIMES SELECTED	EXPECTED NUMBER BASED ON PRE-TEST REL FREQ	DISTRIBU- TION CHI- SQUARED TS VALUE	MTD CHI- SQUARED TEST STATISTIC	LEVEL OF SIGNIFI- CANCE
<u>LEARNING MTD</u>					
BLACKBOARD	47	41.91	0.6171	0.7238	NA
CASE STUDY	53	27.60	23.3696	25.8834	NA
COMPUTER-ASSISTED INSTR	30	26.58	0.4401	0.4855	NA
CONFER W/OTHER STUDENTS	11	25.56	8.2920	9.1113	NA
DEBATE	27	56.23	15.1920	18.9389	****
DEMONSTRATION	6	2.04	7.6519	7.7074	NA
DISCUSS W/INSTRUCTOR	12	11.25	0.0506	0.0527	NA
DRILL AND REPETITION	80	76.67	0.1444	0.1977	NA
EXAMINATION	104	43.96	82.0065	97.0119	****
EXERCISES	15	6.13	12.8157	13.0984	NA
FILMS/VIDEOTAPES	33	41.91	1.8959	2.2239	NA
FLIPCHARTS	24	43.96	9.0621	10.7203	NA
GAMES	24	49.07	12.8087	15.4818	NA
GROUP DISCUSSION	30	36.80	1.2575	1.4446	NA
GROUP PROJECTS	82	56.23	11.8141	14.7279	***
GUEST LECTURER/SPEAKER	36	26.58	3.3386	3.6830	NA
HOMEWORK ASSIGNMENTS	39	18.40	23.0580	24.6543	NA
INDEPENDENT STUDY	16	26.58	4.2112	4.6457	NA
INTERVIEWS	19	30.67	4.4399	4.9770	NA
LABORATORY	22	24.54	0.2620	0.2867	NA
LECTURE	54	52.14	0.0665	0.0815	NA
MEMORIZATION	150	129.83	3.1328	5.7676	*
OBSERVATION	3	10.22	5.1034	5.2938	NA
ORAL REPORTS	60	78.72	4.4506	6.1555	*
PEER TEACHING	70	70.54	0.0041	0.0055	NA
POP QUIZ	91	116.54	5.5981	9.4895	**
PROGRAMMED INSTRUCTION	43	36.80	1.0435	1.1987	NA
READING	33	26.58	1.5507	1.7107	NA
ROLE PLAY	36	73.61	19.2131	25.9283	****
SIMULATIONS	14	13.29	0.0379	0.0398	NA
TERM PAPERS	108	66.45	25.9811	33.9096	****
TUTORIAL	14	17.38	0.6570	0.6998	NA
VIEW GRAPHS	24	32.71	2.3210	2.6229	NA
WORKSHEETS	11	20.45	4.3641	4.7024	NA
TOTALS*	1421	1417.93	296.2517		

<u>LEVEL OF SIGNIFICANCE</u>	<u>SYMBOL</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
NOT APPLICABLE	NA

* Differences between observed and expected totals are due to rounding.

SF: "Least Preferred"

	POST-TEST OBSERVED NUMBER OF TIMES SELECTED	EXPECTED NUMBER BASED ON PRE-TEST REL FREQ	DISTRIBU- TION CHI- SQUARED TS VALUE	MTD CHI- SQUARED TEST STATISTIC	LEVEL OF SIGNIFI- CANCE
<u>LEARNING MTD</u>					
BLACKBOARD	7	6.87	0.0024	0.0029	NA
CASE STUDY	11	4.12	11.4731	12.7024	***
COMPUTER-ASSISTED INSTR	7	5.50	0.4111	0.4720	NA
CONFER W/OTHER STUDENTS	2	3.44	0.5998	0.6524	NA
DEBATE	5	13.05	4.9698	7.1658	**
DEMONSTRATION	2	1.37	0.2850	0.2945	NA
DISCUSS W/INSTRUCTOR	2	2.75	0.2038	0.2178	NA
DRILL AND REPETITION	7	11.68	1.8756	2.5842	NA
EXAMINATION	18	10.31	5.7431	7.5760	**
EXERCISES	2	0.69	2.5087	2.5498	NA
FILMS/VIDEOTAPES	6	6.18	0.0055	0.0064	NA
FLIPCHARTS	5	6.87	0.5095	0.6074	NA
GAMES	4	2.75	0.5700	0.6093	NA
GROUP DISCUSSION	3	2.75	0.0230	0.0246	NA
GROUP PROJECTS	7	7.56	0.0412	0.0501	NA
GUEST LECTURER/SPEAKER	4	5.50	0.4076	0.4680	NA
HOMEWORK ASSIGNMENTS	5	3.44	0.7125	0.7750	NA
INDEPENDENT STUDY	4	2.75	0.5700	0.6093	NA
INTERVIEWS	1	6.18	4.3456	5.0835	NA
LABORATORY	4	2.06	1.8234	1.9161	NA
LECTURE	8	11.68	1.1598	1.5979	NA
MEMORIZATION	17	17.86	0.0418	0.0721	NA
OBSERVATION	0	0.69	0.6871	0.6984	NA
ORAL REPORTS	11	10.31	0.0467	0.0616	NA
PEER TEACHING	7	10.31	1.0608	1.3993	NA
POP QUIZ	15	18.55	0.6799	1.2045	NA
PROGRAMMED INSTRUCTION	4	6.87	1.1996	1.4303	NA
READING	9	5.50	2.2327	2.5635	NA
ROLE PLAY	5	4.81	0.0075	0.0085	NA
SIMULATIONS	3	1.37	1.9235	1.9876	NA
TERM PAPERS	20	10.31	9.1171	12.0268	***
TUTORIAL	3	0.69	7.7857	7.9133	NA
VIEW GRAPHS	3	4.81	0.6809	0.7676	NA
WORKSHEETS	2	3.44	0.5998	0.6524	NA
TOTALS	213	213.00	64.3035		

<u>LEVEL OF SIGNIFICANCE</u>	<u>SYMBOL</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
NOT APPLICABLE	NA

NT: "Least Preferred"

	POST-TEST OBSERVED NUMBER OF TIMES SELECTED	EXPECTED NUMBER BASED ON PRE-TEST REL FREQ	DISTRIBU- TION CHI- SQUARED TS VALUE	MTD CHI- SQUARED TEST STATISTIC	LEVEL OF SIGNIFI- CANCE
<u>LEARNING MTD</u>					
BLACKBOARD	27	21.81	1.2335	1.4484	NA
CASE STUDY	34	8.54	75.9701	80.6532	****
COMPUTER-ASSISTED INSTR	19	15.17	0.9646	1.0756	NA
CONFER W/OTHER STUDENTS	3	12.33	7.0590	7.7053	NA
DEBATE	7	9.48	0.6505	0.6954	NA
DEMONSTRATION	1	0.00	0.0000	0.0068	NA
DISCUSS W/INSTRUCTOR	9	4.74	3.8236	3.9510	NA
DRILL AND REPETITION	47	56.90	1.7235	2.8121	NA
EXAMINATION	59	25.61	43.5488	52.7348	****
EXERCISES	3	6.64	1.9944	2.0887	NA
FILMS/VIDEOTAPES	17	14.23	0.5410	0.5990	NA
FLIPCHARTS	13	29.40	9.1483	11.4354	NA
GAMES	14	28.45	7.3405	9.1022	NA
GROUP DISCUSSION	12	15.17	0.6640	0.7404	NA
GROUP PROJECTS	28	25.61	0.2237	0.2709	NA
GUEST LECTURER/SPEAKER	19	10.43	7.0365	7.5740	NA
HOMEWORK ASSIGNMENTS	17	13.28	1.0437	1.1473	NA
INDEPENDENT STUDY	10	14.23	1.2553	1.3898	NA
INTERVIEWS	5	14.23	5.9832	6.6242	NA
LABORATORY	12	5.69	6.9964	7.2782	NA
LECTURE	36	29.40	1.4816	1.8520	NA
MEMORIZATION	82	78.72	0.1370	0.2949	NA
OBSERVATION	5	5.69	0.0837	0.0871	NA
ORAL REPORTS	26	27.50	0.0822	0.1011	NA
PEER TEACHING	30	26.55	0.4470	0.5455	NA
POP QUIZ	51	64.49	2.8220	5.0276	*
PROGRAMMED INSTRUCTION	28	30.35	0.1817	0.2290	NA
READING	18	11.38	3.8500	4.1731	NA
ROLE PLAY	25	36.99	3.8849	5.1910	*
SIMULATIONS	8	8.54	0.0336	0.0357	NA
TERM PAPERS	38	36.04	0.1067	0.1414	NA
TUTORIAL	12	11.38	0.0337	0.0365	NA
VIEW GRAPHS	10	23.71	7.9274	9.4519	NA
WORKSHEETS	10	9.48	0.0281	0.0300	NA
TOTALS*	735	732.15	198.3001		

<u>LEVEL OF SIGNIFICANCE</u>	<u>SYMBOL</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
NOT APPLICABLE	NA

* Differences between observed and expected totals are due to rounding.

NF: "Least Preferred"

	POST-TEST OBSERVED NUMBER OF TIMES SELECTED	EXPECTED NUMBER BASED ON PRE-TEST REL FREQ	DISTRIBU- TION CHI- SQUARED TS VALUE	MTD CHI- SQUARED TEST STATISTIC	LEVEL OF SIGNIFI- CANCE
<u>LEARNING MTD</u>					
BLACKBOARD	11	5.79	4.6927	5.3184	NA
CASE STUDY	7	2.89	5.8250	6.1891	NA
COMPUTER-ASSISTED INSTR	7	7.24	0.0077	0.0090	NA
CONFER W/OTHER STUDENTS	2	4.34	1.2626	1.3848	NA
DEBATE	2	11.58	7.9220	10.3595	NA
DEMONSTRATION	2	0.00	0.0000	0.0813	NA
DISCUSS W/INSTRUCTOR	5	0.00	0.0000	0.5081	NA
DRILL AND REPITITION	19	15.92	0.5969	0.8823	NA
EXAMINATION	27	10.13	28.0981	35.3827	****
EXERCISES	1	1.45	0.1381	0.1423	NA
FILMS/VIDEOTAPES	4	4.34	0.0268	0.0294	NA
FLIPCHARTS	3	8.68	3.7189	4.5159	NA
GAMES	8	4.34	3.0837	3.3821	NA
GROUP DISCUSSION	4	5.79	0.5525	0.6261	NA
GROUP PROJECTS	13	11.58	0.1750	0.2289	NA
GUEST LECTURER/SPEAKER	7	4.34	1.6284	1.7860	NA
HOMEWORK ASSIGNMENTS	7	4.34	1.6284	1.7860	NA
INDEPENDENT STUDY	3	7.24	2.4792	2.9066	NA
INTERVIEWS	1	1.45	0.1381	0.1423	NA
LABORATORY	6	2.89	3.3331	3.5415	NA
LECTURE	14	11.58	0.5074	0.6635	NA
MEMORIZATION	28	20.26	2.9580	5.0286	*
OBSERVATION	1	1.45	0.1381	0.1423	NA
ORAL REPORTS	8	2.89	9.0079	9.5709	NA
PEER TEACHING	10	5.79	3.0647	3.4733	NA
POP QUIZ	16	24.60	3.0065	6.0130	*
PROGRAMMED INSTRUCTION	6	13.02	3.7878	5.1513	NA
READING	4	2.89	0.4226	0.4490	NA
ROLE PLAY	3	20.26	14.7031	24.9952	****
SIMULATIONS	4	2.89	0.4226	0.4490	NA
TERM PAPERS	7	11.58	1.8092	2.3659	NA
TUTORIAL	3	1.45	1.6666	1.7171	NA
VIEW GRAPHS	3	10.13	5.0179	6.3189	NA
WORKSHEETS	0	2.89	2.8941	3.0750	NA
TOTALS	246	246.00	114.7137		

<u>LEVEL OF SIGNIFICANCE</u>	<u>SYMBOL</u>
p < .05	*
p < .01	**
p < .001	***
p < .0001	****
NOT APPLICABLE	NA

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December, 1989. (AD-A218243).

Vita

Captain Carey F. Tucker was born 2 August 1960 in Dallas, Texas. He graduated from W. W. Samuell High School in Dallas, Texas. He received a Bachelor of Science degree in Business Administration with a major in Accounting from Henderson State University in Arkadelphia, Arkansas. He earned his commission in the Air Force from Officer Training School in 1985 and was assigned to Castle AFB, California as a munitions maintenance officer and later became the Chief of Weapons Safety for the 93rd Bomber Wing. In 1989 he was assigned to Royal Air Force Bentwaters, United Kingdom. He served as the Officer-in-Charge of the munitions branch in the 81st Equipment Maintenance Squadron and deployed to Operation Provide Comfort as the OIC of aircraft maintenance for the 92nd Tactical Fighter Squadron. He is married to the former Gretchen Wilson and has three children, Marc, Andrew, and Tyler.

Permanent Address: 506 Puckett Street
Quitman, Texas 75783

Vita

Captain John W. Underwood was born 7 January 1960 in Orlando, Florida. He enlisted in the United States Army in January, 1981. His initial duty assignment was to Caserma Ederle in Vicenza, Italy as a Unit Supply Specialist. He served there until February, 1984. He was commissioned a Second Lieutenant in the United States Army after graduating from Officer Candidate School at Fort Benning, Georgia in June of 1984. His first assignment was also at Fort Benning as a Company Executive Officer. From there he was transferred to the 59th Ordnance Brigade in Pirmasens, Germany and served as a Brigade Supply Officer and then Company Commander. Captain Underwood is a graduate of the Infantry Officer Basic Course, Quartermaster Officer Advanced Course, and Combined Arms Services Staff School. He graduated from the University of Maryland in 1986, receiving a Bachelor of Science degree in Business Management. He is married to Francesca Underwood and they have two daughters, Danielle and Martina.

Permanent Address: 6713 Volz Ct.

Montgomery, AL 36116

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
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6. AUTHOR(S) Carey F. Tucker, Captain, USAF John W. Underwood, Captain, USA				
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13. ABSTRACT (Maximum 200 words) This research establishes significant relationships between an individual's cognitive style, measured by the Myers-Briggs Type Indicator (MBTI), and the learning preferences of that individual, measured by the Learning Style Survey. The sample consisted of 529 Air Force Institute of Technology graduate students in the School of Systems and Logistics from 1988 to 1992, who completed four tests, pre- and post-tests of both the MBTI and the LSS. This research utilized Chi-Squared Goodness of Fit procedures, determining that some learning methods, techniques, and devices (MTDs) are most or least preferred by all four cognitive types, Sensing-Thinking, Sensing-Feeling, Intuitive-Thinking, and Intuitive-Feeling. Group discussion was significantly most preferred by all types in both the pre-test and post-test, while memorization and pop quizzes were least preferred by all types. Significant differences among the types were noted for both most and least preferred MTDs and significant changes are noted in both cognitive types and learning preferences between pre and post-tests. Recommendations are provided.				
14. SUBJECT TERMS Cognitive Style, Learning Style, Learning Style Survey, Myers-Briggs Type Indicator, Learning MTDs, Individual differences			15. NUMBER OF PAGES 173	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL	

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The purpose of this questionnaire is to determine the potential for current and future applications of AFIT thesis research. Please return completed questionnaires to: DEPARTMENT OF THE AIR FORCE, AIR FORCE INSTITUTE OF TECHNOLOGY/LAC, 2950 P STREET, WRIGHT PATTERSON AFB OH 45433-7765

1. Did this research contribute to a current research project?

- a. Yes b. No

2. Do you believe this research topic is significant enough that it would have been researched (or contracted) by your organization or another agency if AFIT had not researched it?

- a. Yes b. No

3. The benefits of AFIT research can often be expressed by the equivalent value that your agency received by virtue of AFIT performing the research. Please estimate what this research would have cost in terms of manpower and/or dollars if it had been accomplished under contract or if it had been done in-house.

Man Years _____ \$ _____

4. Often it is not possible to attach equivalent dollar values to research, although the results of the research may, in fact, be important. Whether or not you were able to establish an equivalent value for this research (3, above) what is your estimate of its significance?

- | | | | |
|--------------------------|----------------|----------------------------|--------------------------|
| a. Highly
Significant | b. Significant | c. Slightly
Significant | d. Of No
Significance |
|--------------------------|----------------|----------------------------|--------------------------|

5. Comments

Name and Grade

Organization

Position or Title

Address