THE INFLUENCE OF STUDENT CHARACTERISTICS ON ACHIEVEMENT AND ATTITUDES WHEN AN ILLUSTRATED WEB LECTURE IS USED IN AN ONLINE LEARNING ENVIRONMENT

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
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This document is dedicated to my wife Michelle and my daughter Elizabeth for their significant sacrifices that enabled me to pursue my doctorate.

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The purpose of this study was to determine the influence of learning styles, self-efficacy, motivation, and critical thinking dispositions on student achievement and attitudes when an illustrated web lecture is used as the learning activity in an online-learning environment. Dependent variables for this study were student achievement and student attitudes. Independent variables were learning style, motivation, self-efficacy, and critical thinking dispositions. A causal-comparative research design was used to achieve the purpose of this study. A purposive sample of those students enrolled in the online section of an introductory food science course at the University of Florida from the 2003 summer semester was used (n=322). Participants completed self-efficacy, motivation, critical thinking dispositions, learning styles, achievement pre-test, achievement post-test, attitudes, and researcher developed demographic instruments.

Regression analyses were used to develop separate prediction models for achievement and attitudes. Analysis indicated that achievement pre-test scores and

motivation scores accounted for 10.7% of the variance in achievement post-test scores. Analysis also revealed that computer proficiency scores and motivation scores accounted for 5% of the variance in attitude scores.

Multivariate analyses were conducted to determine the influence of each independent variable on achievement and attitudes. The influence of learning style was tested using Multivariate Analysis of Covariance. No differences were found. The influence of motivation, self-efficacy, and critical thinking disposition were tested using canonical correlations and followed with individual regression analyses. Motivation was the only independent variable that influenced attitudes and achievement.

Participants in this study were mainly concrete in their learning style, had high critical thinking dispositions, had high self-efficacy, and were highly motivated. They also had high self-perceived computer skills, but had little previous experience with distance or online education. When an illustrated web lecture is used to deliver content, students with higher motivation tend to exhibit higher achievement and more favorable attitudes toward the instructional strategy. Learning style, self-efficacy, and critical thinking disposition have no significant influence on achievement and attitudes toward the instructional strategy. Based on these findings, recommendations for practitioners and researchers were given.

CHAPTER 1
INTRODUCTION

Formal education has historically taken place on the campuses of universities, colleges, and schools. To receive an education, students were required to attend classes on campus. However, some students were unable or unwilling to attend these classes. In an effort to better meet the needs of these students, alternative methods were explored to deliver instruction. Known as distance education, this practice began as correspondence education in the late 19th century (Simonson, Smaldino, Albright, & Zvacek, 2003). As communications technologies advanced, the methodologies used to deliver distance education followed suit. Telephones, radios, televisions, and satellites have all been used to deliver instruction. The emergence of the Internet and World Wide Web as communications tools yielded yet another avenue for teaching and learning at a distance.

This phenomenon has become commonplace on many university campuses throughout the United States. In 1998, 54% of all higher education institutions either offered, or planned to offer, distance education courses (Lewis, Snow, Farris, Levin, & Greene, 2000). Additionally, nearly 10% of all college students in the United States have taken distance education courses, defined in this report as being strictly off-campus (Sikora, 2002). Countless more students have taken what is commonly referred to as "near-distance" or "hybrid distance" courses, which are situated on-campus. The increased usage of distance methodologies to deliver instruction has led to considerable interest in the area of distance education research due to its differences with traditional face-to-face education.

Much of the initial research completed in distance education focused on comparing distance-delivered courses to those taught by conventional means. Research showed that distance education courses do not have to be exact replicates of on-campus courses to be high quality courses, although distance education researchers in the 1990s spent considerable effort comparing distance-delivered courses to face-to-face courses in an effort to establish distance education as an equivalent educational experience (Miller & Pilcher, 2000; Miller & Shih, 1999; Russell, 1999). In fact, Keegan (1995) presented an equivalency theory that articulates that distance courses should be equivalent, although not exactly the same as traditional courses. This implies that distance courses need not provide identical learning activities as face-to-face courses, but should provide equally valuable learning activities that are suited for distance education.

The second generation of distance education research focused on the characteristics of distance education students (Dutton, Dutton, & Perry, 2002; Lim, 2001; Loomis, 2000). The sum of this research indicates that distance education courses should provide a student-centered learning environment (Jonassen, Davidson, Collins, Campbell, & Haag 1995). However, it was also noted that the separation of students from their instructor creates an environment that places much more responsibility of educational success on the students than is done in a traditional face-to-face classroom (Simonson et al., 2003). Distance students must often recognize their own academic shortcomings and instigate the appropriate actions to overcome them, whereas students in a face-to-face class often rely on cues from the instructor.

In 2000, 60% of all distance education students had at least one course that used the Internet to deliver content (Mayadas, Bourne, & Moore, 2003). This phenomenon

spawned a third generation of distance education research. An indication of this was when a group of faculty and administrators assembled in December 2000 to discuss how to move distance education, specifically online education, beyond just being equivalent to face-to-face classes (Twigg, 2001). Their supposition was that the technological capabilities of an online-learning environment allowed an instructor to make an online class better than a face-to-face class. This group of innovators identified five key features that can improve student learning in an online environment. They were as follows:

1. An initial assessment of each student's knowledge/skill level and preferred learning style
2. Appropriate, varied kinds of human interaction when needed
3. Individualized study plans
4. Built-in, continuous assessment to provide instantaneous feedback
5. An array of high-quality, interactive learning materials and learning activities (Twigg, 2001, p.11)

Delivering content in an online learning environment can take many forms and utilize many learning activities. These learning activities can be synchronous or asynchronous. One such learning activity available in an online learning environment is an illustrated web lecture (Simonson et al., 2003). This asynchronous learning activity seeks to closely mimic the traditional lecture that dominates higher education classrooms. It consists of a text-based presentation, such as PowerPoint, with an audio recording of the instructor presenting the lecture. Recent computer software advances have made creating an illustrated web lecture a relatively simple task. Instructors can easily convert their materials used in a face-to-face class to use in an online environment. Anecdotal evidence suggests that this learning activity is commonly used and therefore was chosen

as the focus of this study. Given the limited amount of research in this area, this learning activity was deemed as good a place as any to begin examining this issue.

Rationale

Planning a quality educational activity begins with knowledge of the students for whom the activity is designed. This pedagogical principle has historical roots. Dewey (1938) argued that teachers must be aware of the past experiences, needs, and capacities of students. Bruner (1966) added that student predispositions, such as cultural, motivational, and personal characteristics, are also important when planning instruction.

In a face-to-face class, the instructor gains this knowledge by personal interactions with the students, which provides a starting point for planning learning activities that are conducive to maximizing the students' learning. At any point during an activity, the instructor has the ability to adjust the direction of the activity based on immediate verbal and non-verbal cues from students. In contrast, the separation of students from the instructor in a distance-learning environment often limits this interaction and feedback from students. As such, instructors have difficulties recognizing when a learning activity is not reaching students. Compounding this issue is that fact that distance-learning activities are often planned and created in advance with limited knowledge of the students who will enroll in a class in a one-size-fits-all approach. However, this does not need to be the case. Distance education, particularly online education, can be individualized or personalized to meet the needs of individual students. As a result of the symposium that addressed this issue, Twigg (2001) stated that

> A fundamental premise of the symposium is that greater quality means greater individualization of learning experiences for students. This means moving away from teaching and learning ideas that begin with the thought that "all students need…" (p. 9)

The common belief that online courses are best suited for certain types of students is erroneous (Twigg, 2001). Online courses can be designed for all types of students. Thus, the design of the course is the critical factor, not the online learning environment. The online-learning environment serves as a virtual classroom.

When compared to the actual learning activities of a face-to-face class, the physical structure of the classroom contributes only minutely to learning, providing that there are no severe physiological or safety issues (Twigg, 2001). The same can be said for an online-learning environment. The actual learning activities contribute more to learning than the online environment. Therein lies a great advantage that an online-learning environment has to offer: the ability to customize learning activities to offer students an individualized learning experience. This concept stands in contrast to the one-size-fits-all approach that dominates traditional face-to-face classrooms (Twigg, 2001).

The Sloan Consortium, which is a group of institutions and organizations dedicated to providing quality online education, also advocated creating an individualized or personalized learning experience in an online-learning environment. Efforts of this group led to the establishment of five pillars of a quality online-learning environment: learning effectiveness, cost effectiveness, access, faculty satisfaction, and student satisfaction (Moore, 2002). According to the Sloan Consortium, quality online learning must address each of these five pillars.

The learning effectiveness pillar provides valuable insight into the notion of individualizing instruction in an online-learning environment. A key to success identified in *Elements of Quality: The Sloan-C Framework* was the "opportunity to personalize learning in innovative ways through approaches that emphasize the uniqueness of

individual learners" (Moore, 2002, p.10). Thus, according to the Sloan Consortium, the characteristics of each student can be used to identify appropriate learning activities.

This ability to individualize, or personalize, instruction allows online education to produce the highest quality learning outcomes for all students. Upon enrolling in an online education course, a student can take an assessment that will determine the learning activities that will best meet his or her needs in learning the content of the course. The instructor may then assemble the appropriate learning activities for each student (Twigg, 2001).

However, this notion for individualized online education is not yet possible (Twigg, 2001). The distance-learning activities that are best suited for different types of students are not readily identified. Specifically, the types of students that are adept at succeeding when an illustrated web lecture is used are not known. Existing distance education research serves as a foundation in examining this issue. However, the research base does not indicate which types of learning activities are best suited for students with differing characteristics. Much of the previous distance education research has examined a series of student characteristics as they affect student achievement and attitudes through an entire course, which is composed of numerous different learning activities (Berg, 2001; Daniel, 1999; Day, Raven, & Newman, 1998; Freeman, 1995; Lim, 2001; Oxford, Park-Oh, Ito, & Sumrall, 1993; Riddle, 1994; Shih & Gamon, 2001). From this research, four characteristics warrant further investigation; these include learning styles, self-efficacy, motivation, and critical thinking dispositions.

Learning styles are the way that people perceive, sort, absorb, process, and retain information (Gregorc, 1982a). As such, different learning activities are better suited for

students with specific learning styles. Research on the effects of learning styles in a distance-learning environment on achievement and attitudes is inconclusive. Several studies reported an effect (Daniel, 1999; Oxford et al., 1993); while others reported learning styles had no effect (Day, Raven, & Newman, 1998; Freeman, 1995). Perhaps the differences in these studies are attributable to the differing learning activities that composed the courses examined by these studies. By isolating a specific learning activity, an illustrated web lecture, the current study sought to further investigate the effect of learning styles.

Self-efficacy is a student's beliefs about his/her capabilities to succeed or perform at an appropriate level (Schunk, 2000). Research on this variable has generally shown that self-efficacy affects student achievement and attitudes (Lim, 2001; Riddle, 1994). However, no studies have been found that examined self-efficacy as it relates to achievement and attitudes toward a specific learning activity, such as an illustrated web lecture.

Motivation is the process whereby goal-directed activities are instigated and maintained (Schunk, 2000). A student with a high degree of motivation towards success in a course will likely be more successful. Student motivation has been shown to influence student attitudes and achievement in a distance-learning environment (Berg, 2001; Shih & Gamon, 2001). As with learning styles and self-efficacy, a deficiency exists in research that examines student motivation as it relates to attitudes and achievement when an illustrated web lecture is used.

Another student characteristic, critical thinking dispositions, has recently gained attention in research related to student attitudes and achievement (Jenkins, 1998). Critical

thinking dispositions are approaches to life that contribute to critical thinking (Facione, 1990). However, research examining this characteristic in a distance-learning environment is very limited. Ricketts, Irani, and Jones (2003) studied the influence of delivery method on critical thinking dispositions. They reported differences between two delivery methods. However, no studies were found that examined the influence of critical thinking dispositions on student attitudes and achievement in a distance-learning environment.

Statement of the Problem

Based on a review of the literature, a research deficiency exists that explains the influence of learning styles, self-efficacy, motivation, and critical thinking dispositions on student attitudes and achievement when an illustrated web lecture is used as a learning activity in a online-learning environment. With this knowledge, instructors could determine if using an illustrated web lecture is appropriate for the students enrolled in their courses. With further research on other distance learning activities, instructors could reach the goal of designing an individualized learning environment for each student based on his or her characteristics. Therefore, the question addressed by this study was: what is the influence of learning styles, self-efficacy, motivation, and critical thinking dispositions on student attitudes and achievement when an illustrated web lecture is used as a learning activity in an online-learning environment?

Purpose

The purpose of this study was to determine the influence of learning styles, self-efficacy, motivation, and critical thinking dispositions on student achievement and attitudes when an illustrated web lecture is used as the learning activity in an online-learning environment. Dependent variables for this study were student achievement and

student attitudes. Independent variables were learning style, motivation, self-efficacy, and critical thinking dispositions. These independent variables can be considered attribute independent variables, which Ary, Jacobs, and Razavieh (2002) define as a variable present in the student prior to the start of the study. The following research objectives and hypotheses guided this study.

Objectives

Three objectives guided this study.

1. Describe the learning styles, critical thinking dispositions, self-efficacy, motivation, and demographic characteristics of participants in this study.
2. Describe the variance in student achievement attributed to learning styles, critical thinking dispositions, self-efficacy, motivation, and student demographic characteristics.
3. Describe the variance in student attitudes attributed to learning styles, critical thinking dispositions, self-efficacy, motivation, and student demographic characteristics.

Null Hypotheses

This study had two dependent variables, achievement and attitudes. Previous research has shown a relationship between these variables (Shih & Gamon, 2001). As such, the null hypotheses were written to accommodate this multivariate relationship. All statistical analyses that involved significance testing were tested at an alpha of .05. This equates to a five percent chance of a Type I error, which occurs if significance was determined, when in fact there really was none.

1. Ho_1: There is no difference in student achievement and attitudes, based on learning styles in the presence of student demographic characteristics.
2. Ho_2: There is no relationship between critical thinking disposition and a linear combination of student achievement and attitudes in the presence of student demographic characteristics.

3. Ho_3: There is no relationship between self-efficacy and a linear combination of student achievement and attitudes in the presence of student demographic characteristics.

4. Ho_4: There is no relationship between motivation and a linear combination of student achievement and attitudes in the presence of student demographic characteristics.

Research Hypotheses

Based on the consulted literature and research, the following research hypotheses were developed.

1. When an illustrated web lecture is used in an online learning environment, concrete learners exhibit greater achievement and exhibit more favorable attitudes than abstract learners.

2. When an illustrated web lecture is used in an online learning environment, students with higher critical thinking dispositions exhibit greater achievement and exhibit more favorable attitudes.

3. When an illustrated web lecture is used in an online learning environment, students with greater self-efficacy exhibit greater achievement and exhibit more favorable attitudes.

4. When an illustrated web lecture is used in an online learning environment, students with a higher motivation exhibit greater achievement and exhibit more favorable attitudes.

Definition of Terms

Several important terms were used throughout this study. Therefore, to precipitate a better understanding, the following definitions were used in this study.

1. Achievement – a measure of the extent to which a person has acquired certain information or skills, often as a result of specific instruction (Ary, Jacobs, & Razavieh, 2002). In this study, achievement was operationally defined as the gain score between the pre-test and post-test on the achievement instrument.

2. Asynchronous learning environment – an educational setting where communication does not take place in real time (Simonson et al., 2003).

3. Attitudes – a person's viewpoint or disposition toward a particular thing (Gall, Gall, & Borg, 2003). In this study, attitude was operationally defined as student perceptions toward an instructional strategy as indicated by a score from the attitudinal instrument.

4. Critical thinking dispositions – approaches to life that contribute to critical thinking (Facione, 1990). In this study, a student's critical thinking disposition was operationally defined as their disposition to innovativeness, maturity, and engagement as indicated by their score on the EMI instrument.

5. Delivery method – the means used to transmit content from the teacher to the student (Simonson et al., 2003).

6. Distance-learning environment – an educational setting that is characterized by separation of the teacher and student in geographic distance, time, or both (Simonson et al., 2003).

7. Face-to-face instruction – an educational setting where the teacher and students are in the same location at the same time (Simonson et al., 2003).

8. Hybrid distance education – an educational setting where a portion of the instruction takes place in a traditional face-to-face classroom and a portion in a distance-learning environment (Simonson et al., 2003).

9. Illustrated web lecture – an online instructional strategy that utilizes a PowerPoint (or similar) presentation with audio to deliver content. A lecture is a learning activity, with or without illustrations, where students passively receive instruction from the instructor (Eggen & Kauchak, 2001).

10. Learning activity – an educational component of a lesson that involves students interacting with the instructor, other students, and content, or a combination of the three (Newcomb, McCracken, & Warmbrod, 1993). In a distance setting, students also interact with the technology used to deliver the instruction (Hillman, Willis, & Gunawardena, 1994; Moore, 1989).

11. Learning style – the way that people perceive, sort, absorb, process, and retain information (Gregorc, 1982a). In this study, learning style was operationally defined as the way they perceive, sort, absorb, process, and retain information, as indicated by their score on the Gregorc Style Delineator.

12. Motivation – the process whereby goal-directed activities are instigated and maintained (Schunk, 2000). In this study, motivation was operationally defined as a score from the motivational instrument that indicates the degree that a student instigates and sustains goal-directed behavior.

13. Near distance – an educational setting where traditional on-campus students receive instruction using distance-learning techniques.

14. Online – characterized by being placed on the Internet (Simonson et al., 2003).

15. Online learning environment – a type of distance-learning environment that is characterized by an educational setting that occurs on the Internet (Simonson et al., 2003).

16. Self-efficacy – students' beliefs about their capabilities to succeed or perform at an appropriate level (Schunk, 2000). In this study, self-efficacy was operationally defined as the score from the self-efficacy instrument that indicates a student's belief about their capabilities to succeed or perform at an appropriate level.

Limitations

The research design utilized to answer a research question determines the limitations of a study. The results, conclusions, and implications of this study have several limitations. They are presented below.

1. A causal comparative research methodology was used in this study. Therefore, it is impossible to establish true cause and effect relationships.

2. The sample used in this study was not randomly selected. Therefore, generalizing the results, conclusions, and implications of this study beyond those participants is limited to this population.

3. Data were collected from only one course during a six-week semester in the summer term of 2003.

4. The population of this study consists of students with an academically successful history.

Assumptions

Several assumptions were made prior to and during this study. The assumptions of this study are presented below.

1. Every person has a learning style and critical thinking disposition that can be determined using a paper instrument.

2. A student self-assessment instrument can determine learning styles, attitudes, motivation, critical thinking dispositions, and self-efficacy.

3. Participants in this study accurately completed the instruments.

Summary

Distance education is a common method of delivering instruction at higher education institutions. As such, many facets of distance education have been studied. Early research focused on establishing the equivalence of distance education to face-to-

face education, whereas more recently, research has addressed student characteristics as they relate holistically to learning in a distance education course.

The technologies used to deliver distance education in an online learning environment have the ability to offer individualized instruction to students based on their characteristics, such as learning styles, critical thinking dispositions, self-efficacy, and motivation. However, the knowledge base does not currently offer empirical evidence that shows which learning activities are better suited for different types of students. Specifically, little is known about how learning styles, self-efficacy, motivation, and critical thinking dispositions influence attitudes and achievement when an illustrated web lecture is used to deliver instruction. Therein lies the research problem of this study. The purpose of this study was to determine if these specific student characteristics had an influence on student achievement and attitudes when taught by an illustrated web lecture in a online-learning environment. This chapter concluded by presenting the specific research questions, null hypotheses, and research hypotheses. Key terms were defined, assumptions were outlined, and limitations were described.

CHAPTER 2
REVIEW OF THE LITERATURE

Chapter 1 outlined the basis for conducting this study. A historical perspective of distance/online education research was presented and a current picture was established. The purpose of this research study was presented, along with specific research questions and hypotheses. Key terms were defined, assumptions were outlined, and limitations were stated.

The last ten years have brought much growth in distance education as a discipline. Some scholars called for the establishment of distance education as a separate, distinct discipline from the mainstream educational discipline (Moore, 1994). As such, they insisted that a separate theoretical framework was necessary for distance education. Other scholars have argued that the teaching and learning processes are the same, regardless of the separation of teacher and students (Shale, 1988). Accordingly, Keegan (1986) postulated that "the theoretical underpinnings of distance education are to be found within general education theory" (p.116). However, Keegan cautioned against using theories based on oral, group based education. Given the limited technological abilities for communication in 1986 and the exponential advances in the communications technologies used in delivering distance education since that time, that caution may be unwarranted today.

The theoretical framework for this study lies in Dunkin and Biddle's (1974) adaptation of Mitzel's model of the learning process (Mitzel, 1960). In this model, the

authors posit that presage variables and context variables influence process variables, which in turn yield product variables (see Figure 2-1).

Presage variables are variables that deal with teacher characteristics (Dunkin & Biddle, 1974). These include teacher formative experiences, teacher training experiences, and teacher properties. Teacher formative experiences include every experience the teacher has prior to preservice teacher education. Teacher preparation experiences include preservice education, attitudes of their instructors, early field experiences, student teaching, in-service education, and post-graduate education. Finally, the teacher properties are the teacher characteristics that the teacher brings into every teaching situation.

Context variables are those variables over which the teacher has little or no control. These include student formative experiences, student characteristics, school and community contexts, and classroom contexts (Dunkin & Biddle, 1974). As with teacher formative experiences, student formative experiences are those experiences that the student has prior to entering the educational experience. Student characteristics are those measurable characteristics that each student brings to the educational process. School and community contexts include the characteristics of the school and community that affect the education process. Classroom contexts are the physical characteristics of the classroom.

Presage variables and context variables influence process variables. Process variables include the actual activities that take place in the classroom (Dunkin & Biddle, 1974). These include the observable behaviors of students and the observable behaviors

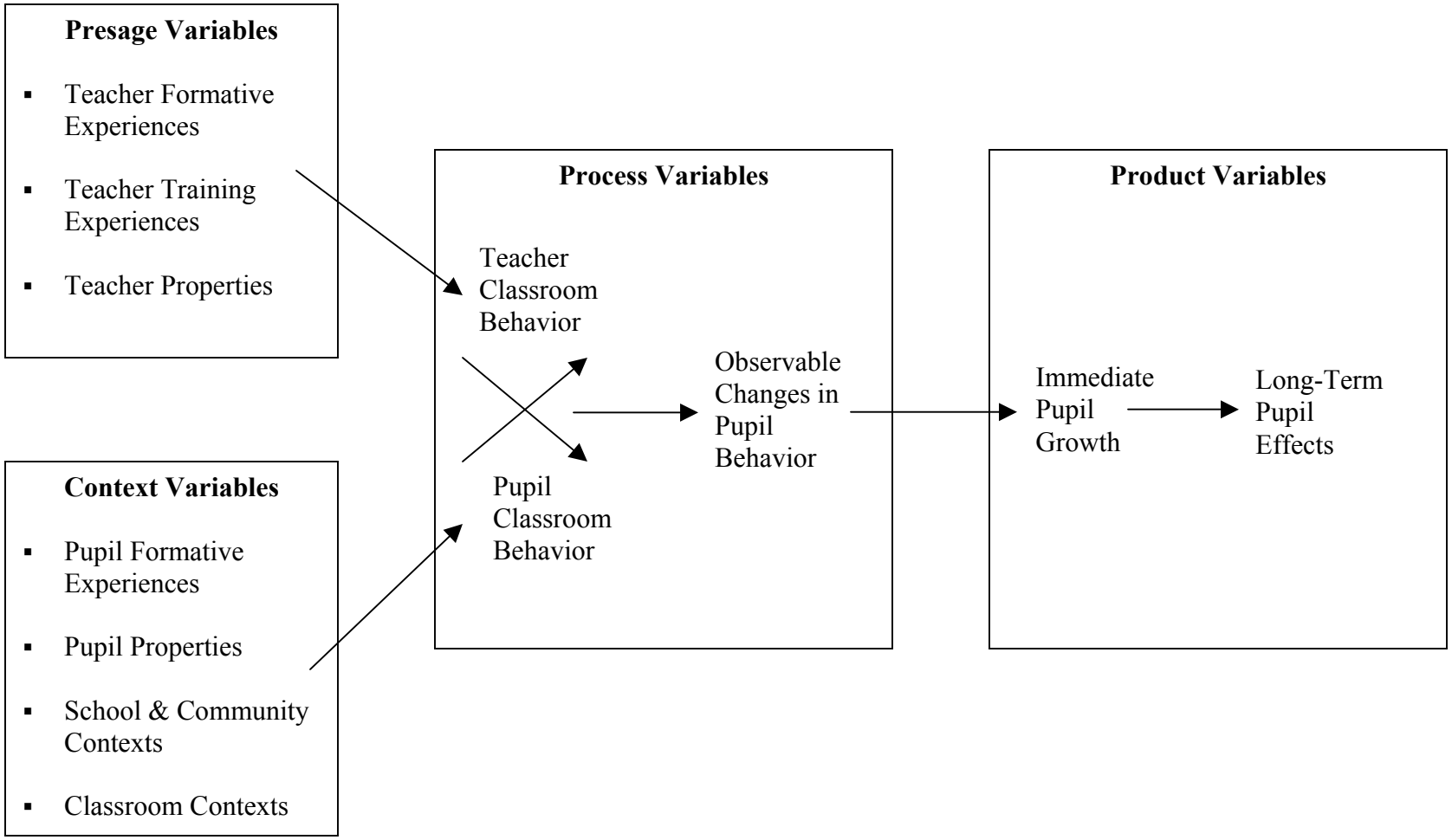

Figure 2-1 Mitzel's Model for the Study of Classroom Teaching (Dunkin & Biddle, 1974)

of teachers. The interaction between observable student behaviors and observable teacher behaviors yields an observable change in student behavior.

Process variables affect product variables. Product variables concern the outcomes of teaching (Dunkin & Biddle, 1974). One measure of outcomes is immediate student growth, which can be measured by evaluating student learning of the subject matter and attitudes toward the subject. Another outcome of the educational process is long-term student effects. These effects could include becoming fit citizens, acquiring the information needed to enter a profession, learning to meet the complex demands of a rapidly changing society, and contributing to the betterment of others.

Although proposed for classroom instruction, Mitzel's model is appropriate for distance-learning environments as well. An assumption in doing so requires that the traditional definition of classroom be expanded to include virtual classrooms created as students interact with the instructor, the content, other students, and the technology in a computer mediated environment (Hillman et al., 1994; Moore, 1989).

Many scholars have proposed theories and models for distance education that are consistent with Mitzel's model. For example, when proposing his Theory of Interaction and Communication for distance education, Borje Holmberg (1989) made the assumption that distance education is an interaction (process variables) between learners (context variables) and teachers (presage variables). He further indicated that student learning determines effectiveness (product variables).

Wedemeyer (1981) proposed a model for distance education that is compatible with Mitzel's model (see Figure 2-2). In his model, Wedemeyer outlines four essential elements in a teaching and learning situation. They are a teacher, a learner, a

communication system, and something to be taught (content). In relation to Mitzel's model, the teacher is represented as presage variables, the learner as context variables, and the communication system and content are represented in the process variables. Missing from Wedemeyer's model are the product variables.

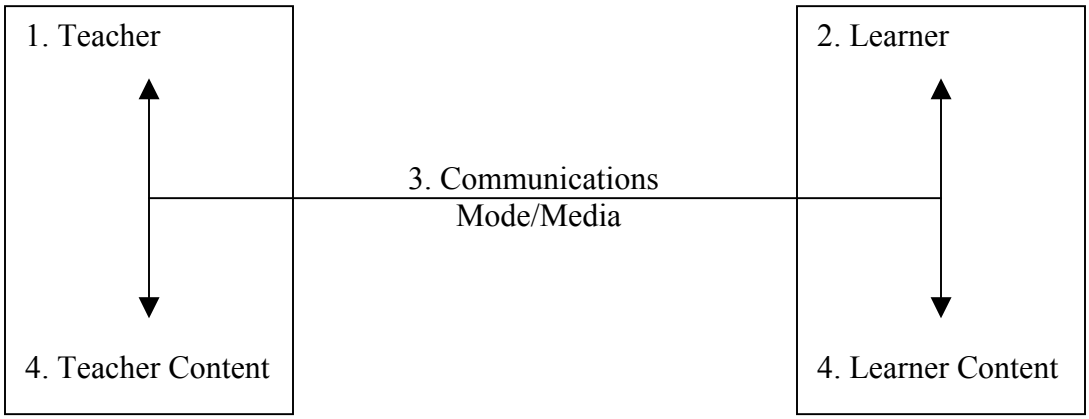

Figure 2-2 Wedemeyer's Teaching-Learning Model for Distance Education (Wedemeyer, 1981)

This study sought to determine the influence of student characteristics (context variables) on student achievement and attitudes (product variables) while holding constant the teaching method (process variable) and instructor (presage variable). As such, relevant research studies on student characteristics and their influence on student achievement and attitudes in a distance-learning environment were consulted. Additionally, research related to characteristics of instructors was also reviewed. The following research was reviewed for this study. The research is presented as it relates to context variables, presage variables, and process variables. Research that addressed product variables was presented within the context of each of the preceding types of variables.

Context Variables

Learning Styles

People have preferred ways of absorbing, processing, and retaining information (Schunk, 2000). Not synonymous with academic ability, this preference is often called a learning or cognitive style. The terms learning style and cognitive style are often used interchangeably (James & Gardner, 1995). Gregorc (1982a) defined learning styles as the way that people perceive, sort, absorb, process, and retain information. Witkin and Goodenough (1981) elaborated that cognitive styles are individual differences in how people process information. Similarly, James and Gardner (1995, p. 19) defined learning style, "the ways individual learners react to the overall learning environment make up an individual's learning style. " Dunn and Dunn (1993) added that both biological and developmental characteristics contribute to a student's learning style.

Numerous instruments exist to assess different aspects of learning styles. James and Gardner (1995) presented a model of learning styles with three dimensions. The perceptual dimension identifies ways that people assimilate information from physiological or sensory input. The cognitive dimension addresses how people store and retrieve information. The affective dimension encompasses personality and emotional characteristics. These dimensions are useful to differentiate between various instruments used to assess learning styles.

The perceptual dimension focuses on how people collect information from the environment (James & Gardner, 1995). This includes input from the five senses and input from physiological aspects, such as speech or movement. Obrien (1989) identified three perceptual modalities of auditory, visual, and kinesthetic that address student's sensory preferences for inputting information. According to James and Gardner (1995), French

(1975) expanded this list to seven elements, including visual, print, aural, interactive, haptic, kinesthetic, and olfactory. Based on this work, the Multi-Modal Paired Associates Learning Test was developed to assess perceptual learning styles.

The cognitive dimension addresses a student's way of perceiving, thinking, problem solving, and remembering (James & Gardner, 1995). One approach to assessing cognitive learning style uses a dichotomous scale of field-dependence and field-independence as reported by the Group Embedded Figures Test (GEFT) (Witkin & Goodenough, 1981), whereas others have proposed that assessing cognitive learning styles requires a more a multidimensional approach. Gregorc (1982b) developed the Gregorc Style Delineator with the dimensions of Concrete Sequential, Concrete Random, Abstract Sequential, and Abstract Random. Kolb (1984) created the Learning Style Inventory (LSI), which classifies students as having convergent, divergent, assimilation, or accommodative learning styles.

The affective dimension addresses the student's personality as it relates to attention, emotion, and valuing. A common instrument used to assess personality type is the Myers-Briggs Type Indicator (MBTI), which uses four scales to identify sixteen personality types (Myers, 1992). The four scales are Extroversion – Introversion, Sensing – Intuition, Thinking – Feeling, and Judgment – Perception. James and Gardner (1995) presented other measures of affective learning styles that include the Keirsey Temperament Sorter (Keirsey & Bates, 1984) and Honey and Mumford's Learning Styles Questionnaire (Honey & Mumford, 1989).

Summary of Learning Styles Research Relevant to Distance Education

Learning styles have often been the focus of research in distance learning. These studies are consistent with the model presented by Dunkin and Biddle (1974) that asserts

that individual differences in students can affect the outcomes of the educational experience. However, the conclusions drawn from these studies conflict. As such, the effects of learning styles on student achievement in distance education courses are inconclusive.

Freeman (1995) used a quasi-experimental study to compare an interactive video-conferencing delivery method to a traditional face-to-face classroom in medical technology courses. Her independent variables were the delivery method and student learning style, as measured by Kolb's Learning Style Inventory (Kolb, 1984). The dependent variable of this study was achievement, which was measured by post-tests and a national certification exam. This study reported a statistically significant difference in achievement in only one of eight topic areas when using delivery method as the independent variable and no significant differences when using learning styles as the independent variable. She also reported no significant difference when examining the interaction between delivery method and learning style.

In a study of 99 students enrolled in a web-based distance education course, Shih and Gamon (2001) studied the relationships between student achievement and learning styles using the Group Embedded Figures Test to determine learning styles. Additionally, they assessed student attitudes using an attitudinal instrument modified from Miller (1995a). They reported that over two-thirds of the students in their sample were field independent. Their results showed no significant difference between field independent and field dependent students in performance, as measured by course grades. They found no significant differences in attitudes, based on learning styles. They concluded that students with differing learning styles and attitudes learned equally well in a web-based

course. Motivation, defined as the degree that a student instigates and sustains goal-directed behavior, was the only statistically significant factor in this study.

Oxford et al. (1993) presented research that examined student factors that affected achievement in a high school foreign language course delivered by satellite. Learning styles were measured by using the Learning Channel Preference Checklist, which assesses students on the three scales of visual, auditory and haptic. Achievement was measured by the Japanese Language Achievement Test. Their results conveyed that learning styles did affect student achievement.

In a similar study, Day et al. (1998) used a post-test only experimental design to determine the effects of web-based instruction on student achievement and attitudes in an agricultural communications course that focused on technical writing. Achievement was measured by using questions from the class midterm exam and a major class project. The researchers developed an attitudinal instrument to measure attitudes. They used the Group Embedded Figures Test to measure learning styles. They concluded there were no significant differences between field independent and field dependent students in achievement or attitudes.

Daniel (1999) used a randomized factorial experimental design to determine if the delivery method and learning styles affected achievement in physical therapy graduate students. The delivery methods tested were interactive television and asynchronous computer-aided instruction. Learning styles were measured using Kolb's Learning Style Inventory (Kolb, 1984). Achievement was measured using a researcher-developed test. In direct contrast to the study discussed above (Freeman, 1995), he reported that learning styles were statistically significant in predicting student achievement. Additionally, a

statistically significant interaction between learning style and delivery method was also reported.

Riddle (1994) examined a series of student characteristics in an effort to explain the variance in achievement and attitudes of undergraduate students in Maine and North Dakota. She used the Group Embedded Figures Test to determine learning style and course grade to measure achievement. The results showed that the state of residence and field dependence accounted for 45% of the variance in course grade. However, learning style was not statistically significant when predicting attitudes.

Loomis (2000) conducted a study to determine the relationship between learning styles and achievement in an undergraduate research methods course delivered in an asynchronous, web-based learning environment. Learning styles were assessed using the Learning and Study Strategies Inventory (LASSI), which consists of ten scales, each measuring a different component of learning. Scores on class assignments and exams were used to determine student achievement. Five of the ten LASSI scales had significant correlations with student achievement. He concluded that student learning styles played a crucial role in student success in this study.

Kranc (1997) conducted a study to ascertain if student characteristics and demographics were predictive of student attitudes and achievement in a telecommunications course delivered to North Carolina health professionals. Learning styles were the primary student characteristic analyzed in this study. The Kolb and Canfield Learning Styles Inventories were used to assess learning styles. A researcher-developed instrument measured attitudes, and a post-test instrument determined

achievement. This study reported that learning styles are predictive of student attitudes towards methods of instruction, but are not predictive of achievement.

In addition to student achievement, learning styles have been used to assess other aspects of distance education. Miller (1997) conducted a study to describe the learning strategies used by students in a distance delivered course that used videotapes as the delivery method. He also sought to explore the relationships between learning styles and the learning strategies that students used. A researcher-developed instrument was used to determine learning strategies employed by students. The Group Embedded Figures Test was used to determine learning styles. The results of this study indicated that field independent and field dependent students used very similar learning strategies while in a distance education course delivered by videotape.

Other research has shown that learning styles affect specific activities within a course. Becker and Dwyer (1998) used a quasi-experimental design to investigate the effects of learning styles on attitudes towards a delivery method that incorporated an online groupware project into a face-to-face class. The researchers assessed learning styles using the Individual Differences Questionnaire, which classifies students as either verbal or visual learners. They assessed student attitudes towards an instructional method with an attitudinal instrument. The results of this study indicated that students with a visual learning style perceived the groupware software to be more effective.

In a study at the University of Florida, Rudd and Telg (1998) compared learning styles with student grades in two undergraduate courses delivered by interactive video conferencing. Both on-campus and off-campus students were enrolled. The researchers used the Group Embedded Figures Test to determine learning style and course grades to

determine achievement. They reported an observable, but not statistically significant, relationship between learning style and achievement.

In an exploratory study of the affective domain of cognitive styles, Biner, Bink, Huffman, and Dean (1995) examined the relationship between student personality type and achievement. Their sample included undergraduate and graduate students. The researchers used the 16PF instrument to assess student personality type and course grades to determine achievement. Their results indicated that certain personality traits influenced student success. Participants in their study who were self-sufficient and introverted performed significantly higher in course performance.

In a study of graduate students at the University of Florida, Irani, Scherler, Harrington, and Telg (2001) used a causal comparative design to explore if student demographic factors and personality type are related to student attitudes and achievement. Personality type was measured using the Myers-Briggs Personality Type Indicator. Attitudes were assessed using a modified version of Biner's (1993) attitudinal instrument. Achievement was represented as course grade. The researchers collected data from 39 students. They concluded that personality type was correlated with student attitudes and achievement.

Critical Thinking

Critical thinking is a term used frequently in educational circles. However, a universal definition is not yet accepted for critical thinking. Paul and Nosich (1991) present a definition from the National Council for Excellence in Critical Thinking Instruction.

> Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing or evaluating information

> gathered by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. (p.4)

Peter Facione (1990) conducted a Delphi study to determine the constructs that compose critical thinking. Facione's study used 40 experts to arrive at consensus. His study serves as the basis for much of the recent research conducted on critical thinking. Facione developed the following definition:

> We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. Critical thinking is essential as a tool of inquiry. As such, critical thinking is a liberating force in education and a powerful resource in one's personal and civic life. While not synonymous with good thinking, critical thinking is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent is seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and circumstances will permit. Thus, educating good critical thinkers means working toward this ideal. It combines developing critical thinking skills with nurturing those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society. (p. 3)

In a thorough review of the above-mentioned definitions and other literature, Rudd, Baker, and Hoover (2000) proposed their own definition, that "critical thinking is a reasoned, purposive, and introspective approach to solving problems or addressing questions with incomplete evidence and information and for which an incontrovertible solution is unlikely" (p.5). This definition will be used as the basis for discussing critical thinking in this study.

Facione's (1990) Delphi study also revealed that there are two aspects of critical thinking, dispositions and skills (also called abilities). The researcher refers to dispositions as approaches to life that contribute to critical thinking. He identified seven components of critical thinking disposition as: inquisitiveness, open-mindedness,

systematicity, analyticity, truth seeking, self-confidence, and maturity (Facione, 1998). In contrast, critical thinking skills are actual abilities possessed by people that are critical thinkers. The 1990 study also identified interpretation, analysis, evaluation, inference, explanation, and self-regulation as critical thinking skills.

Critical Thinking Research Relevant to Distance Education

Little research exists that examines critical thinking as it relates to student achievement and attitudes in a distance-learning environment. The literature base indicates that critical thinking is likely predictive of student success in traditional courses. However, the effects of critical thinking in a distance-learning environment have not been adequately explored.

In a study that compared a traditional course to a distance delivered course, Ricketts et al. (2003) examined how delivery method affected critical thinking dispositions and attitudes. Their sample included 20 students in the distance course and 21 in the traditional course. To determine the change in critical thinking dispositions, the researchers used a pre-test/post-test design. Their results indicated that there were statistically different changes in sub-scale scores in critical thinking dispositions between the two delivery methods. The researchers indicated a possible reason for the difference between the two groups could be decreased opportunities for interaction. This study also reported no differences between the delivery methods in student attitudes. They did not report the relationship between critical thinking dispositions and attitudes.

Jenkins (1998) conducted a study using a traditional face-to-face course to determine if critical thinking ability was predictive of student achievement. Critical thinking ability was assessed using the Watson-Glaser Critical Thinking Appraisal (W-GCTA) and student grades on examinations were used to assess achievement. Her sample

included 96 undergraduate accounting students at San Jose State University. The researcher reported that student GPA was the most influential predictor of student achievement. However, on the last two examinations, critical thinking ability was also significant. Jenkins hypothesized that the students developed a greater critical thinking ability as the course progressed and thus it affected achievement on the last two examinations.

In a study that sought to determine if a relationship exists between learning styles and critical thinking, Rudd et al. (2000) collected data from 174 undergraduate students in the College of Agricultural and Life Sciences at the University of Florida. The Group Embedded Figures Test (GEFT) was used to assess learning styles and the California Critical Thinking Disposition Inventory (CCTDI) was used to determine critical thinking dispositions. Interestingly, the researchers found significant differences between genders, however, no significant differences based on learning styles.

Torres and Cano (1995a) conducted a study to describe the cognitive levels of graduating seniors from the College of Agriculture at The Ohio State University. Their sample included 196 students. They used the Developing Cognitive Abilities Test (DCAT) to determine critical thinking abilities. They sought to describe the students in their sample based on their application abilities, basic cognitive abilities, and critical thinking abilities. Their results indicated that students scored highest on the application abilities and lowest on the critical thinking abilities. When examining gender, no differences were reported on basic cognitive abilities and critical thinking abilities. A statistically significant difference was reported on application abilities; however, the researchers indicated that this difference was impractical (77.4% for males, 71.5% for

females). The researchers also reported slight differences between groups of students based on their academic major.

In a related study, Torres and Cano (1995b) examined the same 196 college seniors from the College of Agriculture at The Ohio State University to explain critical thinking as influenced by learning styles. They also used the GEFT to measure learning styles. Results of this study indicate that the student's GEFT score accounted for 9.1% of the variance in critical thinking abilities, as measured by the DCAT.

In an earlier study, Cano and Martinez (1991) sought to determine the relationship between cognitive performance and critical thinking ability. The sample used in this study included 385 students enrolled in secondary agricultural education programs in Ohio. The DCAT was used to assess cognitive level performance and the W-GCTA was used to determine critical thinking abilities. Results of this study indicated that a positive relationship existed between cognitive performance and critical thinking abilities.

Self-Efficacy

The foundation for self-efficacy theory is found in social cognitive theory, particularly the work of Albert Bandura (Pajares, 2002). Bandura (1986) asserted that a reciprocal relationship exists between personal factors, environmental factors, and behavior. The model of triadic reciprocality portrays this relationship (see Figure 2-3).

Of particular importance to social cognitive theory is the concept that personal factors, which include cognitive, biological, and affective events, are related to behavior and environmental factors (Pajares, 2002). One such personal factor is self-efficacy. Pajares (2002, ¶ 14) asserted that, "of all the thoughts that affect human functioning, and standing at the very core of social cognitive theory, are self-efficacy beliefs." Bandura (1997) defined self-efficacy as, "beliefs in one's capabilities to organize and execute the

courses of action required to produce given attainments" (p. 3). Bandura also indicated that, "people's level of motivation, affective states, and actions are based more on what they believe than on what is objectively true" (p. 2). Therefore, in an educational setting, self-efficacy can influence achievement and attitudes (Pajares, 2002).

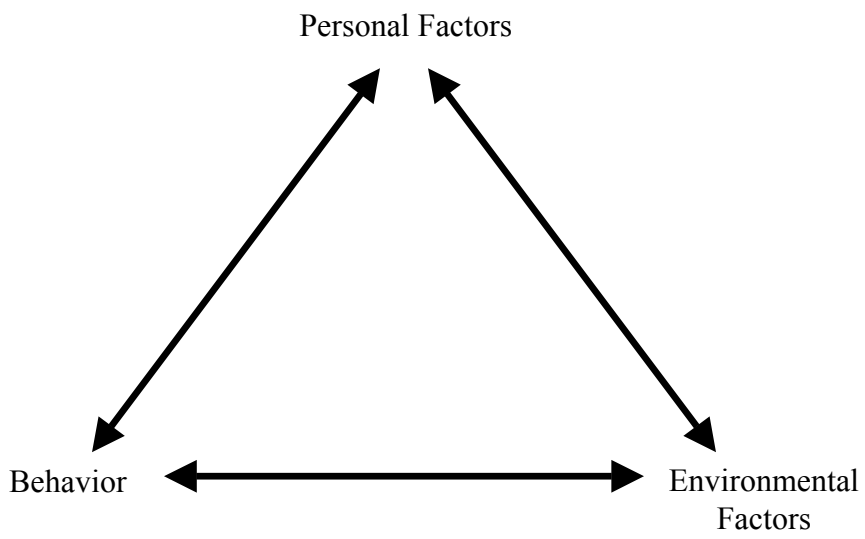

Figure 2-3 Model of Triadic Reciprocality (Bandura, 1997)

Self-efficacy is influenced by mastery experiences, vicarious experiences, social influences, and physiological or emotional states (Bandura, 1997). Thus, previous personal successes, watching others succeed, being told that he/she can succeed, and positive biological feedback can all increase a student's self-efficacy. It is important to note that influencing self-efficacy by vicarious experiences can occur by observing models, particularly peer models (Schunk, 2000). Therefore, a student's self-efficacy can be increased by observing another student, viewed as a peer, succeed at a similar task or in a similar situation.

Self-efficacy is domain specific, which means that a person can be efficacious with regards to one topic or situation and non-efficacious about another (Pajares, 1996). For

example, it is plausible that a student may be efficacious about learning in a face-to-face classroom, but non-efficacious about learning in a distance-learning environment. Distance education often places students in an educational setting that differs from traditional face-to-face classrooms. Learning in a new setting has the potential to affect students' beliefs about his/her capabilities to succeed or perform at an appropriate level.

Self-Efficacy Research Relevant to Distance Education

A limited number of studies have examined self-efficacy as it relates to achievement and attitudes in a distance-learning environment. These studies indicate that student self-efficacy is influential on achievement and attitudes in a distance-learning environment.

In a study of a web-based course, Lim (2001) examined factors that explain the variance in student attitudes. Lim included demographics variables, self-efficacy, and numerous measures of computer experience when constructing the model, self-efficacy was measured by using an adaptation of the Computer User Self-Efficacy Scale (Eachus & Cassidy, 1996). A researcher-developed instrument was used to assess student satisfaction. Lim concluded that learner self-efficacy, specifically computer self-efficacy, was the only statistically significant predictor of student satisfaction in the presence of other variables included in the study.

In another study, Riddle (1994) studied factors that contributed to student satisfaction in courses delivered by interactive video networks. Riddle included learning styles, self-efficacy, and a host of demographic variables in the study. Researcher-developed instruments were used to measure both self-efficacy and satisfaction. It was concluded that self-efficacy contributed to explaining the variance in student satisfaction in a distance education course.

In an evaluative study of a distance education program, Laughlin (1998) examined student self-efficacy as it relates to student attitudes towards if the objectives of each course were met. Her sample included 27 recent graduates from the program. The researcher developed an instrument to assess both student self-efficacy and attitudes. This study concluded that student self-efficacy, related to meeting course objectives, was a valid means of evaluating a distance education course.

Motivation

Motivation is defined as "the process of instigating and sustaining goal-directed behavior" (Schunk, 2000, p. 300). The action of setting goals and self-monitoring progress towards those goal lies within a cognitive perspective. Pintrich, Smith, Garcia, and McKeachie (1993) went further by presenting a model of motivation theory that lies within social cognitive theory. Bandura (1997) also indicated that motivation lies within social cognitive theory. In the context of the model of triadic reciprocality, motivation is a personal factor (see Figure 2-3).

In discussing how motivation is generated, Bandura (1997) said that people "form beliefs about what they can do, they anticipate likely positive and negative outcomes of different pursuits, and they set goals for themselves and plan courses of action designed to realize valued features and avoid aversive ones" (p. 122). Expectancy-value theories are often used to explain motivation. These theories indicate the strength of motivation is influenced by the expectation that a particular action will produce specific outcomes and the attractiveness of those outcomes (Bandura, 1997).

Pintrich (1988) presented an expectancy-value model that consisted the constructs of expectancy, value, and affect (see Figure 2-4). The expectancy construct was composed of a student's perceptions of self-efficacy and beliefs about controlling their

own learning. Intrinsic goal orientation, extrinsic goal orientation, and task value beliefs composed the value construct. Intrinsic goal orientation was a focus on learning and mastery of the content. In contrast, extrinsic goal orientation was a focus on grades and approval of others. Task value beliefs were judgments on how useful the content is to the student. The affective construct was operationalized by a student's test anxiety. Pintrich et al. (1993) developed the Motivated Strategies for Learning Questionnaire (MSLQ) based on this model.

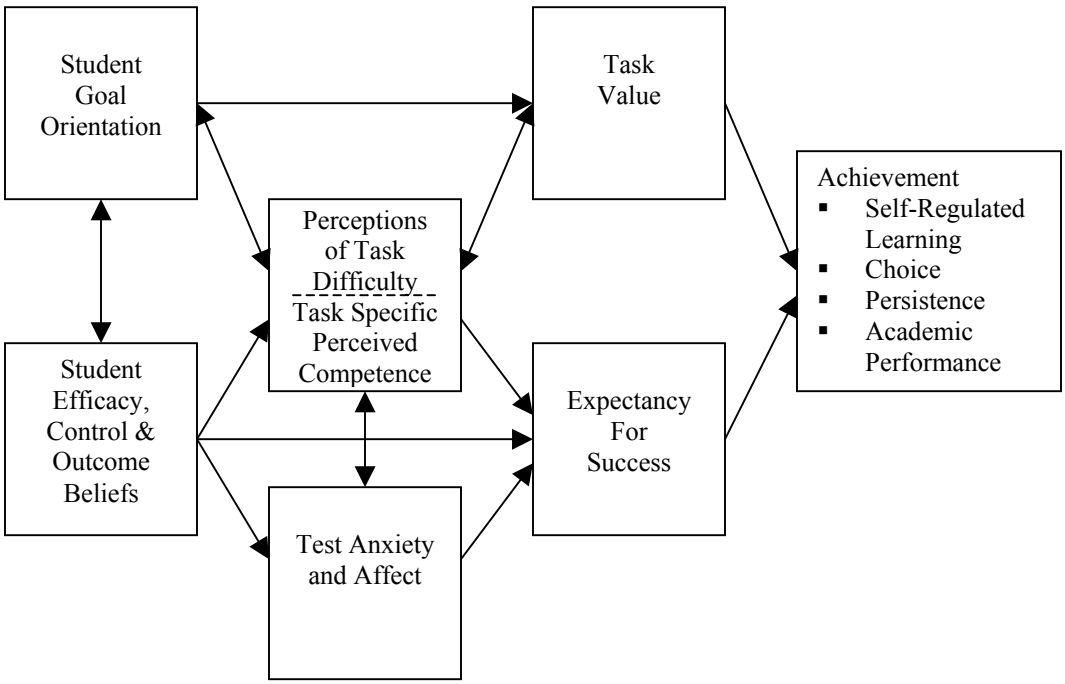

Figure 2-4 Components of Motivation (Pintrich, 1988)

Motivation plays an important role in learning (Bandura, 1997; Schunk, 2000). Motivation serves to engage students in activities that help increase learning. People with greater motivation tend to expend greater effort when they encounter difficult material, rather that quit. Motivation is also related to the use of cognitive and meta-cognitive

strategies (Garcia & Pintrich, 1995). In summary, motivation affects academic performance.

Summary of Motivation Research Relevant to Distance Education

Several studies examined how motivation affects student achievement and attitudes in distance-delivered courses. Results from these studies indicate that student motivation affects their success in a distance education course.

Shih and Gamon (2001) studied 99 students enrolled in two courses delivered via the web. In this study, learning styles, motivation, and attitudes were examined for their effects on achievement. Achievement was determined by course grade. An adapted version of the Motivation Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1993) was used to assess student motivation. The researchers reported that student motivation accounted for over one-fourth of student achievement as measured by course grades.

Using mixed methods, Mauldin (2001) conducted a study to determine the dimensions that increase the effectiveness of distance courses, as measured by student attitudes. Both focus groups and surveys were used to collect data. Mauldin's sample included undergraduate students enrolled in a health sciences program. Results of this study indicated that student attitudes of the perceived effectiveness of a distance course are influenced by motivation.

In a study of high school students enrolled in a distance-delivered foreign language class, Oxford et al. (1993) examined a series of variables to identify factors that affected performance. One of these variables was motivation, measured by the Motivation Survey (MS) developed by Rainey (1991). Achievement was measured using the Japanese Language Achievement Test (JLAT). The researchers developed a model using

regression analysis and reported that student motivation is a significant factor in predicting achievement.

Zalenski (2001) studied a different measure of success in a distance delivered course, attrition. The sample of this study included 815 undergraduate students in a liberal studies program. The researcher reported that motivation, or lack of motivation, can also affect graduation and attrition rates in a distance education.

A contributing factor to student motivation the reasons they enrolled in a distance delivered course. Miller and Honeyman (1993) studied students enrolled in a distance delivered course that used videotapes as the delivery method. Their sample included 200 graduate students from the College of Agriculture at Iowa State University. This descriptive study reported that earning bachelor's degrees, master's degrees, or a need for personal development all motivated students to enroll in distance courses.

Another study by Miller (1995b) sought to investigate obstacles to distance students. The sample for this study included all bachelor's and master's degree graduates from the College of Agriculture at Iowa State University in 1993. Similarly to the above-mentioned study, Miller conveyed that the primary motivation for graduate students to enroll in distance courses was to earn an advanced degree.

In yet another study from Iowa State University, Bruce Miller (1992) examined a series of groups to evaluate motivation for enrolling in distance courses. His sample included all students enrolled in off-campus programs during the 1987-1988 school year. The researcher reported that cognitive interest was the single largest motivation. He went further to indicate that professional development was the highest motivation for agricultural students. When comparing students working on a bachelor's degree to those

working on a master's degree, this study showed that master's students were more motivated by social contact and social stimulation than the bachelor's students.

Berg (2001) conducted research to compare students enrolled in a distance-delivered community college course to students in a face-to-face course of the same content. As part of this study, Berg examined student motivations for enrolling in the distance sections of the course. This study concluded that age and motivation were the only significant variables in differentiating between successful distance students and successful students in a face-to-face.

Computer Related Variables

The effects of student characteristics related to computer proficiency and computer usage are uncertain when trying to predict student achievement and attitudes in a distance-learning environment. Several studies examined factors associated with computer proficiency and usage.

The anxiety involved in using this technology was a variable studied by Sexton, Raven, and Newman (2002). Their sample included 26 extension agents enrolled in a distance delivered inservice program. They reported that computer anxiety did not affect performance of extension agents in an in-service training conducted via the web.

Dutton et al. (2002) conducted a study that compared online students to traditional students. As part of this study, the researchers examined numerous variables, including the previous experience of students with computers. Results from this study indicate that a student's prior experience with computers improved their performance as measured by course grades.

Brouard (1996) presented research conducted to identify relationships between student characteristics and their attitudes towards distance education courses. One of the

characteristics examined was student computer literacy. Brouard's sample included 319 students enrolled in four different universities in Florida. Results of this study indicate that when modeled alone, computer literacy was significant to student attitudes. However, when other variables were added to the model, computer literacy was not significant. The researcher also reported that technology acceptance was significant to student attitudes.

Previous Experience

A student's previous experience with distance education is inconclusive as a predictor of student success in a distance-learning environment. Lim (2001) conducted a study to develop a predictive model of student satisfaction in a web-based course. Numerous variables were examined, including the students' previous experience. Lim (2001) reported that in the presence of other variables, a student's previous experience was not a significant predictor of student satisfaction.

Cheung and Kan (2002) sought to examine student characteristics that contributed to achievement in distance courses. Their sample consisted of 168 students enrolled in a business communications class. The researchers reported a significant relationship between previous experience and achievement.

Numerous other studies have reported the number of courses or previous experiences with distance education that the participants had (Miller, 1992; Miller, 1997; Miller & Pilcher, 2002; Oxford et al., 1993). Yet, none of these studies looked at how these previous experiences affected students' success in courses.

Isolation

Student isolation does not appear to be a predictor of student success in a distance-learning environment. Bandura (1986) contended that people learn in dynamic social

environments. These environments consist of interactions with other students, the instructor, and the physical surroundings. Distance education students often have little or no face-to-face interaction in the courses they take. As a result, they are often isolated. This isolation can lead to student loneliness.

One study examined the construct of loneliness as a possible predictor of student persistence in a distance course (Pugliese, 1994). The sample for Pugliese's study consisted of 306 community college students in New York enrolled in courses delivered as telecourses. The researcher examined how many factors, including loneliness, affected attrition. Results of this study indicate that loneliness was not significant in predicting attrition.

Work Related Characteristics

Given that many distance education students are part time students who usually work, it is worthwhile to examine work related characteristics. Several studies have addressed this issue. These studies indicate that a student's occupation or work related characteristics affect their success in a distance education course.

A study by Dutton et al. (2002) compared traditional students to online students on the number of hours they worked per week. They reported that online students worked nearly twenty more hours per week than traditional students. Of notable interest, their results indicated that working had a negative impact on performance in this course. In addition to performance, they reported that classes that conflict with work were a significant reason for these students selecting an online delivered course.

In a study of graduation and attrition in distance education courses, Zalenski (2001) collected data from 815 students. The purpose of this study was to identify variables that could predict graduation. The study reported that students who receive financial support

from their employers are more likely to graduate. Another finding of this study was that students that work long hours are less likely to graduate.

Student Demographics

Age

The effects of age are inconclusive in predicting student success in distance education courses. In a study that examined student characteristics and attitudes towards distance instruction delivered by videotape, Miller and Honeyman (1993) reported that greater than 58% of the students in their study were over 30 years old. Consistent with andragogical theory (Knowles, 1980), they concluded that the age of students in this study gave them a "considerable amount of life and educational experiences related to agriculture" (p. 90). However, this study did not use age as predictor of student attitudes towards the distance deliver method.

Similarly, Dutton et al. (2002) reported the average age of students in an online class was 27.6 while the average age in a traditional lecture class was 22.5. The researchers also compared the student achievement between the online group and the traditional group. They reported that the online group had significantly higher exam grades and higher (but not statistically significant) course grades. However, they did not specifically use age in the model when comparing achievement between the two groups.

Brouard (1996) conducted a study to determine the relationship between student characteristics, including age, and their attitudes towards distance education. His sample included 319 students from four universities in Florida. Results of this study indicated that age and status were the only significant student characteristics associated with attitudes.

In a study of undergraduate students in an English composition course delivered by interactive video conferencing, Berg (2001) sought to compare students enrolled in the distance sections to face-to-face sections. Berg's results indicated that age and motivation for selecting the delivery method were significant in differentiating between successful and unsuccessful distance students in a writing intensive course.

Irani et al. (2001) studied University of Florida graduate students in an interactive video conferencing course to determine how demographic variables affected student attitudes and achievement. An attitudinal instrument adapted from Biner (1993) was used to assess student attitudes and achievement was determined by course grade. The researchers reported moderately strong correlations between age and attitudes towards instructional technology and course management (r = .41 and r = .44, respectively).

Academic standing

Academic standing has not been shown to predict student success in a distance-learning environment. Students enrolled in distance classes usually have a higher academic standing (i.e., senior, graduate student, etc.). Miller and Honeyman (1993) reported that over 65% of the students in their study had a bachelor's degree and an additional six percent had a master's degree. In an undergraduate soils course, Murphy (2000) reported that nearly 84% of the students were juniors or seniors. This information, together with the plethora of studies that show no significant difference in student achievement between on-campus and off-campus courses (Russell, 1999), indicate that academic standing is not a significant predictor in student success. Russell (1999) conducted a meta-analysis of studies that compared teaching with technology to teaching without technology. Some controversy exists about this research. However, ample research that examined agriculturally related distance education exists that is consistent

with Russell's findings (Born & Miller, 1999; Miller & Pilcher, 2000; Miller & Shih, 1999). As such, Russell's (1999) findings were deemed applicable here.

Other studies have looked at how academic standing affected other aspects of distance education. Lim (2001) reported that academic standing did not affect student perceptions of web-based instruction. However, Miller (1992) reported that academic standing affected student motivational factors.

Gender

Many researchers have included gender as part of the design of their studies. When reviewing these studies, however, the effects of gender are inconclusive on student achievement in distance education. Some studies reported differences between genders, while others did not.

In a study of high schools students enrolled in a foreign language course delivered by satellite, Oxford et al. (1993) reported that gender was influential in predicting student achievement in a distance course in the presence of other variables. Scores on the Japanese Language Achievement Test were used to assess achievement. The researchers reported that there was a significant difference between males and females on motivation scores. They also reported a different, but not statistically significant, score in achievement between males and females.

Lim (2001) conducted a study to develop a prediction model for student attitudes in web-based distance courses. The sample for this study included 235 students enrolled in five different universities. In this study, a series of variables, including gender, were used in the model. When fitting the model with all the variables, 15% of the variability was explained. The researcher also indicated that there was a negative relationship between

gender and satisfaction. However, Lim did not indicate how gender was coded for entry into the model and as such, it is impossible to ascertain the differences between genders.

Ory, Bullock, and Burnaska (1997) conducted a study to determine if there is a difference in attitudes between males and females when an asynchronous learning network is used to deliver instruction. The researchers collected data from over 2000 students at the University of Illinois – Urban Champaign. Two researcher-developed instruments, one for computer conferencing and the other for web delivered courses, were used to measure student attitudes. Based on their findings, they concluded that there were no significant differences in attitudes based on gender.

Presage Variables

Biner (1993) undertook the task of developing a course evaluation instrument for distance courses delivered by interactive television. In doing so, he presented fours steps. The first was generating items, the second was defining the dimensions, the third was selecting content valid items, and the fourth was writing and pretesting the items. The researcher used a sample of 50 students enrolled in distance courses to collect data in the first round. The second round used seven content matter experts to verify results from round one. The third round eleven individuals to validate the content. One construct identified in this study was instructor/instruction. Sixteen items were included in this construct. Each item used a five point Likert-type scale from very poor to very good. These sixteen items indicate the instructor and instruction variables that influence student perceptions of course quality. The sixteen items are presented in Table 2-1.

Subject matter knowledge

An instructor characteristic not addressed in the Biner (1993) study was subject matter knowledge. Common sense would suggest that an instructor should have adequate

Table 2-1 Instructor Rating Items From the Telecourse Evaluation Questionnaire (Biner, 1993)

Item
1. The clarity with which the class assignments were communicated.
2. Your reaction to the typical amount of time the prepared graphics (e.g., graphs, tables, pictures, outlines, notes, etc.) were left on the screen to be copied down.
3. The degree to which the computer-generated graphics and PowerPoint slides helped you gain a better understanding of the course material.
4. The production quality of the prepared graphics used for the class.
5. The timeliness with which papers, tests, and written assignments were graded and returned.
6. The degree to which the types of instructional techniques that were used to teach the class (e.g., lectures, demonstrations, group discussions, case studies, etc.) helped you gain a better understanding of the class material.
7. The extent to which the instructor made students feel that they were part of the class and "belonged."
8. The instructor's communication skills.
9. The interaction between the instructor and students at the various sites.
10. The instructor's organization and preparation for class.
11. The instructor's general level of enthusiasm.
12. The instructor's teaching ability.
13. The extent to which the instructor encouraged class participation.
14. The in-person/telephone accessibility of the instructor outside of class.
15. The instructor's professional behavior.
16. Overall, this instructor was

Note. The Likert scale for these items went from 1 – Very Poor to 5 – Very Good.

subject matter knowledge to be effective. Research in distance education does not specifically address an instructor's subject matter knowledge. However, many studies compared distance delivered courses to traditional courses. One component of this comparison is often student perceptions of instructors and instructor subject matter knowledge. Research generally supports the position that students perceive instructors who teach in a distance-learning environment to be equally competent in regards to subject matter knowledge as their counterparts who teach traditional courses.

In a study that compared off-campus courses to on-campus courses, Miller and Pilcher (2000) used the four constructs of manufacturing-based, user-based, value-based, and transcendent-based as the basis for course quality. A component of the manufacturing-base construct was instructor subject matter knowledge. The researchers collected data from 173 graduate students enrolled in distance delivered courses and 262 faculty members from the College of Agriculture at Iowa State University. Their results showed that no differences in student assessments of instructor subject matter knowledge between off-campus and on-campus courses. However, these same students indicated that off-campus courses are of lower quality that on-campus courses in the manufacturing-based construct.

Using the same data, Miller and Shih (1999) examined only faculty perceptions of the quality of off-campus to on-campus courses. Evaluating the data this way revealed that faculty perceived a difference in quality, with on-campus courses having the higher quality. Specifically, faculty perceived the manufacturing-based and transcendent-based constructs to be different.

Beare (1989) conducted a study to compare three methods of delivering instruction. This quasi-experimental study compared audiotaped, videotaped, and telecourses. The dependent variables were student attitudes and achievement, as measured by percentage correct on examinations. The independent variables were content, instructor's performance, relevance of course materials, overall ranking, instructor's knowledge, time requirement, and stimulating subject matter. No differences between the groups were found.

Communication abilities

The nature of distance education involves a separation of the students and the instructor. This separation can be by geography, time, or both. This separation necessitates effective communication between the instructor and the students. Research indicates that an instructor's communications abilities influence student outcomes in a distance-learning environment.

McCleary and Egan (1989) conducted a quasi-experimental study that compared interactive video courses to traditional courses. The dependent variables included student achievement, instructor effectiveness, learner receptivity, and course design features, which included visual material, course organization, and feedback. Significant differences were found in comparison of interactive video courses to traditional courses in visual materials, organization, and instructor feedback to students. These results indicate that instructor feedback is important to student attitudes in a distance-learning environment. This is consistent with the findings of Biner (1993).

Process Variables

Process variables include the actual activities that take place in the learning environment (Dunkin & Biddle, 1974). In a distance-learning environment, these

activities are composed of interactions that occur between the learner and teacher, the learner and other learners, the learner and content, and the learner and the technology (Hillman et al., 1994; Moore, 1989). These interactions are precipitated through the learning activities used by the teacher. However, little is empirically known about the effectiveness of specific learning activities used in a distance-learning environment, including an illustrated web lecture. As such, relevant research that addressed interaction in a distance-learning environment was reviewed to gain insight into process variables.

In a study of faculty perceptions about web-based distance education, Born and Miller (1999) surveyed faculty members of the Department of Agronomy at Iowa State University. At the time, this department was beginning a new distance delivered Master of Science degree program. Surveyed faculty members were positive about the ability to deliver a distance program that was as challenging as their on-campus program. However, they were most concerned about the effectiveness of interaction between the instructor and students. Regardless, the faculty thought that web-based courses were of value and that more courses should be developed and integrated into the curriculum.

In a study that sought to identify the strengths, weaknesses, opportunities, and threats to distance education, Murphrey and Dooley (2000) interviewed 42 people involved in delivering distance education from the College of Agriculture and Life Sciences and Texas A & M University. This group included administrators, faculty, and support staff. Based on their interviews, the researchers identified a loss of interaction and weak communication channels as a weakness of distance education. As such, they recommended that training be conducted to address pedagogy in a distance environment.

Murphy (1999) conducted a causal-comparative study to investigate the actual amount of interaction that occurred between the instructor and students in a distance course delivered using two-way audio and two-way video interactive video conferencing. The researcher observed 15 class sessions that ranged from just under an hour to almost two hours. The findings of this study indicated that the amount of interaction between the instructor and students in the distance learning environment was not fundamentally different that the amount of interaction in a traditional on-campus course.

King and Doerfert (1995) conducted a study that sought to determine student differences in interaction needs based on the delivery method used in a course. In doing so, the researchers examined classes delivered face-to-face, using interactive video, and using videotapes. Data was collected using six courses that were offered by each of the delivery methods. A total of 115 students completed a 68-item questionnaire that sought to determine their perceptions about the delivery method and opportunities for interaction in their course. Based on their findings, the researchers concluded that personal contact is needed between the instructor and students regardless of delivery method. Only a slight desire for interaction with other students was reported, regardless of delivery method. All students desired high quality interaction with the technology. Interestingly, students enrolled in courses delivered by videotape had a lower need for interaction. Given their choice to enroll in a class using this delivery method, this might be expected.

In a study that sought to determine the preferences, performance, and perceived interaction needs of graduate students, Gray and Miller (1999) used a questionnaire to collect descriptive data from 113 students that were enrolled in distance classes at Iowa State University. The questionnaire used Likert-type items to assess the four types of

interaction as identified by Moore (1993) and Hillman et al. (1994). The researchers concluded that according to graduate students, interaction with the content was the most important criterion, followed closely with interaction with the instructor.

Kelsey (1999) used case study research methods to investigate interaction in a course delivered by interactive video technology. Specifically, the researcher examined the theory that increasing interaction increases student satisfaction. The researcher reported that students were very satisfied with the number and variety of opportunities for interaction. This study went further and identified ten potential barriers to interaction in a distance-learning environment. These included: social concerns, technology limitations, lack of time, content related issues, camera shyness, site facilitators' behavior, needing more time for processing content, lack of non-verbal clues, distance, and having to press the microphone mute control knob.

In a study that examined only learner-instructor and learner-learner interaction, Vrasidas and McIsaac (1999) used class observations and interviews to ascertain the instructor's and the students' perspectives about interaction in a web-based course. The course used was a hybrid that met face-to-face and through online technologies. Results of this study indicated that the structure of the course, class size, feedback, and prior experience with computer mediated communication all influenced interaction.

Chapter Summary

This chapter sought to provide a review of the literature related to the research problem of this study. In doing so, a theoretical background was formed using Mitzel's model of instruction (Dunkin & Biddle, 1974). Distance education theories were presented that are consistent with this theory. These included Wedemeyer's Teaching-Learning Model for Distance Education (Wedemeyer, 1981), Theory of Interaction and

Communication (Holmberg, 1989), and the four types of interaction (Hillman et al., 1994; Moore, 1989).

Relevant research related to context variables of distance education students was summarized. This research indicated that student self-efficacy, motivation, and work related characteristics were all influential on student outcomes in a distance-learning environment. Whereas research presented suggested that student isolation and academic standing had no effect on student outcomes, the effects of cognitive style, computer experience, previous experience, age, and gender are all inconclusive. Research that addressed the effects of critical thinking dispositions on student outcomes was not found, so critical thinking research from general education was presented. Further research was discussed that how presage variables in a distance-learning environment related to student outcomes. Finally, research that examined specific learning activities in a distance-learning environment, including an illustrated web lecture, was not found. As such, research that investigated interaction between the learner and instructor, the learner and other learners, the learner and the content, and the learner with the technology was presented. Based on the research consulted, a conceptual model was developed to guide this study (see Figure 2-5).

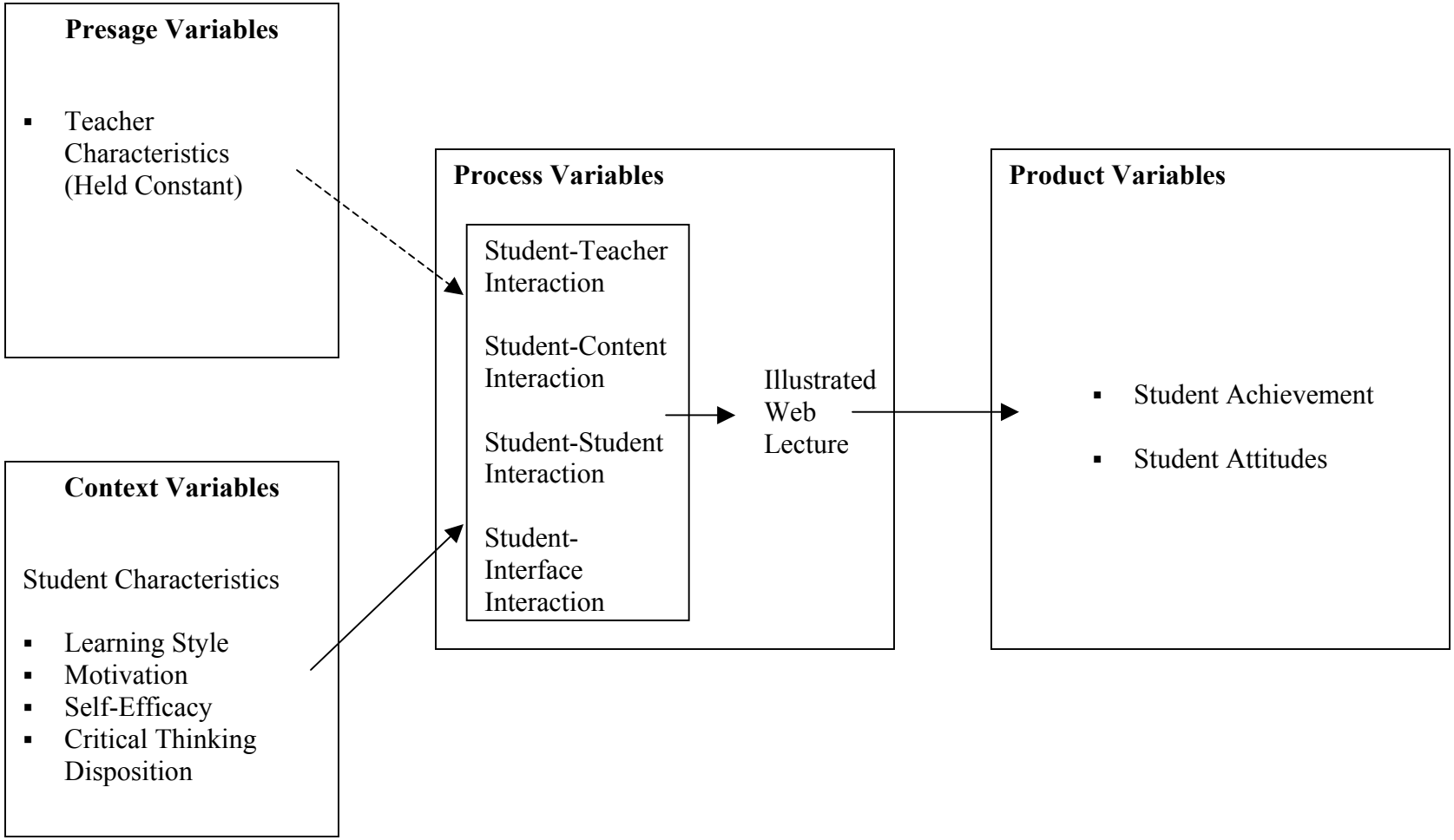

Figure 2-5 A Conceptual Model for Examining the Influence of Student Characteristics on Achievement and Attitudes When an Illustrated Web Lecture is Used in an Online Learning Environment

CHAPTER 3
METHODS

Chapter 1 outlined the basis for conducting this study. A historical perspective of distance education research was presented and a current picture was established. The purpose of this research study was presented, along with specific research questions and hypotheses. Key terms were defined, assumptions were outlined, and limitations were stated.

Chapter 2 provided a theoretical and conceptual framework for studying this topic. A thorough background on learning styles, critical thinking dispositions, self-efficacy, motivation, and other variables in the context of distance education was presented. Relevant literature and research were consulted to do so.

This chapter outlines the research methodology employed in this study. As such, the research design, procedures, population and sample, instrumentation, data collection, and data analysis are addressed.

The purpose of this study was to determine the influence of student learning styles, critical thinking dispositions, motivation scores, and student self-efficacy on student achievement, as measured by a gain in content knowledge, and student attitudes in an online-learning environment course that used an illustrated web lecture as the learning activity. The attribute independent variables in this study were student learning styles, critical thinking dispositions, motivation, and student self-efficacy. Ary et al. (2002) defined an attribute independent variable as a variable present in the student prior to the

start of the study. The dependent variables were student achievement and student attitudes.

This study also addressed several antecedent variables. To account for differences in prior knowledge of students, pre-test scores on the achievement test were used as a covariate. Gender, computer proficiency, employment, experience, and grade point average were also included as antecedent variables.

Research Design

This study used a causal-comparative design (Gall et al., 2003). This design was chosen because a cause and effect relationship is hypothesized between the independent and dependent variables. However, Ary et al. (2002) caution that true cause and effect relationships cannot be ascertained by causal comparative studies. The independent variables were attribute independent variables, thus they were already present in the subjects of this study, and as such, random assignment and manipulation of variables was not achievable. Gall et al. (2003) defined causal-comparative research as:

> a type of nonexperimental investigation in which researchers seek to identify cause-and-effect relationships by forming groups of individuals in whom the independent variable is present or absent – or present at several levels – and then determining whether groups differ on the dependent variable. (p. 296)

Causal-comparative research designs are similar to experimental designs in the organization and presentation of variables (Gall et al., 2003). The statistical procedures employed in causal-comparative studies are also often similar to experimental designs. However, conclusions and inferences about true causality in a causal-comparative study are impossible (Ary et al., 2002). Observed relationships between dependent and independent variables may be the result of a spurious relationship. Ary et al. (2002) defined a spurious relationship as a relationship that, "is one in which the two variables

really have no effect on each other but are related because some other variable influences both" (p. 337).

The hypothesized relationship investigated by this study was that the independent variables influence the dependent variables after the subjects receive the treatment. The treatment in this research design was presenting content using an illustrated web lecture as the learning activity in an online learning environment.

Two dependent variables were evaluated in this study: student attitudes towards the instructional strategy and student achievement. These were determined following the treatment. A pre-test was used to statistically control for student prior knowledge on the achievement test. Four attribute independent variables were included in this research design: student learning styles, motivation, self-efficacy, and critical thinking dispositions. Again, these were assessed prior to students receiving the treatment.

Threats to internal validity were addressed in the design of this study. Campbell and Stanley (1963) identified eight threats to internal validity. These include history, maturation, testing, instrumentation, statistical regression, selection, mortality, and interaction between these threats. These threats were addressed as follows:

1. History is the events that occurred between the first and second measurement of a study (Campbell & Stanley, 1963). In this study, only achievement has two measurement points. History was addressed by minimizing the time between the two measurement points.

2. Maturation is the change in subjects attributed to the passage of time (Campbell & Stanley, 1963). As with history, this was addressed by a short data collection period.

3. Testing is the effect of taking a test on the scores of the second test (Campbell & Stanley, 1963). This threat was addressed in this study by using parallel forms for the achievement pre-test and post-test.

4. Instrumentation is changes in how instruments were scored or measurements were taken. This study used electronic data collection to eliminate researcher errors in scoring and objective measurements of variables.

5. Statistical regression occurs when participants are selected based on extremes on a selection variable (Campbell & Stanley, 1963). This was not an issue in this study, as participants were not selected based on any characteristic. The characteristics of participants were measured in naturally occurring environments.

6. Selection is a threat to internal validity when there is a bias in selecting participants (Campbell & Stanley, 1963). Again, this study did not select participants based on their characteristics, rather they were selected and then their naturally occurring characteristics were measured.

7. Mortality is the loss of participants during the study (Campbell & Stanley, 1963). To overcome this threat, the data collection period of this study was short.

8. The final threat is the interaction of any of the previously mentioned threats (Campbell & Stanley, 1963). To overcome this threat, thorough relationships were examined between all variables in the study.

Procedures

The data collection period for this study was six weeks during the 2003 summer semester at the University of Florida. This represented the duration of the course selected for this study, which was an undergraduate introductory food science course that attracted students from many academic disciplines. The data collection of this study was divided into three two-week periods. All data collection occurred using web-based forms. The instructor of the course administered the achievement post-test, which also served as the second examination in the course.

Great effort was taken to merge the data collection of this study with regular instructional activities of the course. To accomplish this, all instrumentation was linked from the course web page and was designed to appear as if it were a normal part of the course.

During the first two weeks (weeks 1 and 2), participants completed a four-part web-based instrument that assessed motivation, self-efficacy, and critical thinking dispositions. The instrument also collected demographic information from the participants. Participants were instructed to complete this instrument on the first day of class. A link from the course web site allowed participants to easily access the instrumentation. Ten days after data collection began, participants were sent an email reminding them to complete the achievement pre-test (see Email Reminder 1, Appendix E).

The second two weeks of the data collection (weeks 3 and 4) involved administration of the achievement pre-test and post-test. The pre-test was developed as a web-based instrument that students completed prior to receiving the treatment. Participants were directed to take the pre-test by a link from the course web site.

The treatment was a section of this course delivered using an illustrated web lecture instructional strategy. This section represented one-third of the content of this course and equated to nearly six hours of illustrated web lecture. Participants were able to receive this treatment from streaming videos located on the course web site. As a backup, copies of the streaming videos were also available for checkout at the library. Following the treatment, the instructor used a web form to administer the post-test, which also served as the second examination in the course. Upon completion of this portion of the study, participants were sent an email to remind them to complete the last portion of the study (see Email Reminder2, Appendix E).

The final two-week period of this study (weeks 5 and 6) consisted of assessing learning styles and student attitudes about the illustrated web lecture instructional

strategy. This was accomplished by using a web-based instrument that was linked from the course web site. A final email from the researcher advised participants to complete this last part of the study (see Reminder Email 3, Appendix E).

This study was approved by the University of Florida Institutional Review Board (approval #2003-U-399). A copy of the approval can be seen in Appendix F.

Population and Sample

The population of this study was all students that were, are, or will be enrolled in the online section of FOS 2001 *Man's Food* course at the University of Florida, delivered using an illustrated web lecture. This course was chosen because it was accessible and utilized illustrated web lectures for a considerable amount of the content delivery. A purposive sample of those students enrolled in the online section of this course from the 2003 summer semester was used (n=322). This sampling method was deemed appropriate as Ary et al. (2002) indicated that in purposive sampling, "sample elements judged to be typical, or representative, are chosen from the population" (p.169). This sample was deemed to be representative of the population based on previous enrollments of this course (M. Marshall, personal communication, April 10, 2003).

Instrumentation

Numerous instruments were used to assess the variables of interest in this study. When possible, existing instruments with established validity and reliability were employed. Each instrument, along with its reliability and validity, is discussed below.

Learning Styles

Learning styles were assessed using the Gregorc Style Delineator (Gregorc, 1982a). This instrument was chosen based on its ability to separate learners into four distinct learning styles and the relative ease to create an electronic version of the instrument. This

instrument uses a series of words that participants must order (see Appendix D). By analyzing the ordering, students are assigned to one of four learning styles. These four styles are Concrete Sequential, Concrete Random, Abstract Sequential, and Abstract Random. When establishing reliability for this instrument, it was administered to 110 adults twice (Gregorc, 1982b). Alphas for Concrete Sequential were .92 and .92, Concrete Random were .91 and .91, Abstract Sequential were .89 and .92, and Abstract Random were .93 and .92.

Validity for this instrument was evaluated on the basis of construct validity and predictive validity (Gregorc, 1982b). Construct validity was determined by interviewing over 100 people who had taken the Gregorc Style Delineator. Gregorc reported that nearly all participants found the descriptions based on their learning styles to be accurate. Predictive validity was determined by using correlations between the Gregorc Styles Delineator scores and attribute scores provided by participants on two sets of participants. The Concrete Sequential construct yielded correlations of .68 and .70, the Concrete Random had correlations of .55 and .68, the Abstract Sequential construct had correlations of .68 and .76, and the Abstract Random construct had correlations of .61 and .60. The instrument was delivered in a web-based format. The layout and content of the web-based instrument were identical to the paper version.

Critical Thinking Dispositions

Critical thinking dispositions were assessed using the Engagement, Maturity, and Innovativeness Critical Thinking Disposition Inventory (EMI) (Ricketts, 2003). The EMI is based on original work conducted by Facione (1990). The EMI was developed after Moore, Rudd, and Penfield (2003) found significant discrepancies in the California

Critical Thinking Dispositions Inventory (CCTDI). Through factor analysis, the constructs of Engagement, Maturity, and Innovativeness were identified.

Face validity of the instrument was established by a review of an expert panel (Ricketts, 2003). Construct validity was established by using the original work of Facione (1990). Ricketts reported reliabilities of .75 for the Innovativeness construct, .57 for the Maturity construct, and .86 for the Engagement construct. Slight changes were made in an effort to improve the reliability of the Maturity construct (see Appendix A).

Motivation Instrument

The motivation instrument used in this study is attributable to Shih and Gamon (2001), who developed the instrument based on original work by Pintrich et al. (1993). This instrument was chosen because of its usage in a similar study and its prior use as an online form (Shih & Gamon, 2001). This instrument utilized nine statements designed to assess the degree to which a student instigates and sustains goal-directed behavior (see Appendix A). A Likert-type scale accompanied each statement. An expert panel in the College of Agriculture at Iowa State University confirmed the instrument's content and face validity. Reliability was assessed using Cronbach's alpha (r = .71).

Self-efficacy Instrument

The self-efficacy instrument was developed by Riddle (1994). This instrument was chosen due to its development specifically for distance education and its prior usage as an online form. Based on work by Bandura and a thorough review of existing literature, Riddle developed 17 Likert-type items that explained a student's self-efficacy towards success in a distance-learning environment (see Appendix A). Data collected during Riddle's study yielded a Cronbach's alpha for this instrument of .81.

Demographics Instrument

A researcher-developed instrument was utilized to collect demographic data in this study (see Appendix A). The instrument was developed for use as a web-based instrument. An expert panel in the Department of Agricultural Education and Communication at the University of Florida evaluated face and content validity. Because questions had "an accurate, ready-made answer", the questions did not elicit demands for considerable time, thought, nor variation and therefore posed no reliability risks (Dillman, 2000).

Achievement Test

The instructor of the class used as the sample in this study, FOS 2001 *Man's Food,* developed the achievement post-test (see Appendix C). This was deemed appropriate, as the instructor is the subject matter expert. The test consisted of 100 single-response multiple-choice questions. The researcher created a parallel form to use as the achievement pre-test (see Appendix B). Ary et al. (2002) defined a parallel form as one that is as similar as possible in content, difficulty, length, and format. This was achieved in this study by altering the ordering of the questions, altering the ordering of the responses for each question, and rewording questions from the achievement post-test. Both tests were evaluated for face validity by an expert panel in the Department of Agricultural Education and Communication at the University of Florida. The instructor of the course evaluated the instruments for content validity. Post hoc reliability analysis yielded a Kuder-Richardson-20 score of .82 for the pre-test.

Attitudinal Instrument

Miller and Honeyman (1993) developed the attitudinal instrument consisting of 13 Likert-type items that assessed student attitudes toward videotaped instruction. Shih and

Gamon (2001) made slight modifications to this instrument and used 11 items to assess student attitudes towards web-based instruction. This instrument was chosen because of its usage in a similar study and its prior usage as an online form (Shih & Gamon, 2001). A panel of experts from the College of Agriculture at Iowa State University was used to assess content and face validity. The Cronbach's alpha coefficient for this instrument was .91. The version used by Shih and Gamon was used in this study to assess attitudes. Slight wording changes were made in this instrument to focus on an illustrated web lecture (see Appendix D).

Data Collection

Data were collected at four points in this study. A web-based form that contained the critical thinking dispositions instrument, the self-efficacy instrument, the motivation instrument, and the demographics instrument was administered during the first week of the course (see Appendix A). As students submitted their responses to this web-based form, their data were simultaneously emailed to the researcher and saved on a server. Upon conclusion of this portion of the data collection, the data were imported into a spreadsheet program for data organization and storage.

The second data collection point was the administration of the achievement pre-test (see Appendix B). This was also administered as a web-based instrument. As with the above instrument, student responses were concurrently emailed to the instructor and saved on the server. Upon completion of this data collection period, this data were also downloaded from the server and imported into a spreadsheet program.

The third data collection point was the administration of the achievement post-test (see Appendix C). This was also administered as a web-based instrument, by the instructor of the course. This instrument also served as the second examination for this

course. Upon scoring the examinations, the instructor furnished scores for each student to the researcher.

The final data collection point of this study occurred during the last week of the course. A web-based form was used to administer the learning styles and the attitudinal instruments (see Appendix D). As with the other web-based forms, the researcher concurrently received and email and the data was saved on the server as each participants submitted their responses. Upon completion of this data collection period, the researcher downloaded the data from the server and imported it into a spreadsheet program.

Analysis of Data

Data were analyzed using the SPSS ® for Windows™ statistical package. The sample was described using descriptive statistics. Likert-type items were treated as interval data (Clason & Dormody, 1994). Multiple regression was used to explain the variance in student achievement and attitudes based on the independent variables. Prior to performing the regression, correlations were used to examine the relationships between the variables and identify potential multicollinearity problems. Specifically, backwards regression was used to select the best model for predicting achievement post-test scores using learning styles, critical thinking dispositions, self-efficacy, motivation, student demographic characteristics, and achievement pre-test scores. This procedure was used because it utilizes all available variables to build a model that consists of only variables that contribute significantly to predicting the dependent variable (Agresti & Finlay, 1997).

Research hypotheses were tested using multivariate techniques. The hypothesis that contained a nominal independent variable was tested using a Multivariate Analysis of Covariance (MANCOVA) procedure. MANCOVA is a procedure used to compare

differences in groups with multiple dependent variables while statistically controlling for covariates (Ary, Jacobs, & Razavieh, 2002). The hypotheses that contained interval independent variables were tested using canonical correlation analysis. Canonical correlation analysis is the appropriate analysis to determine if a relationship exists between multiple interval independent variables and multiple interval dependent variables (Stevens, 1992).

Chapter Summary

In this chapter, the methods employed to answer the research questions and test the hypotheses identified in Chapter 1 were discussed. In doing so, the research design, procedures, population and sample, instrumentation, data collection, and data analysis were addressed.

The independent variables in this study were student learning styles, critical thinking dispositions, motivation scores, and student self-efficacy. The dependent variables were student achievement scores and student attitudes. Achievement pre-test scores, gender, computer proficiency, employment, experience, and grade point average were also included as antecedent variables. The design of this study was identified as causal-comparative. The attributes of this design were discussed. Threats to validity were also outlined.

The population of this study was identified as all students that were, are, or will be enrolled in the online section of FOS 2001 *Man's Food* at the University of Florida. The sampling method was identified as purposive and a justification for that method was given. The sample was identified as all students enrolled in the online section from the 2003 summer semester (n = 322).

The instruments used in this study were discussed. They included the Gregorc Learning Styles Delineator, the EMI, a self-efficacy instrument, a motivation instrument, a demographics instrument, an attitudinal instrument, an achievement pre-test, and an achievement post-test. The development, validity, and reliability for each instrument were outlined. The methods of collecting the data from each of these instruments were also discussed. Finally, the methods of analyzing this data were presented. These methods included multivariate analysis of covariance, canonical correlations, multiple regression, and correlations.

CHAPTER 4
RESULTS AND DISCUSSION

Chapter 1 outlined the basis for conducting this study. A historical perspective of distance education research was presented and a current picture was established. The purpose of this research study was presented, along with specific research questions and hypotheses. Key terms were defined, assumptions were outlined, and limitations were stated.

Chapter 2 provided a theoretical and conceptual framework for studying this topic. A thorough background on learning styles, critical thinking dispositions, self-efficacy, motivation, and other variables in the context of distance education was presented. Relevant literature and research were consulted to do so.

Chapter 3 outlined the research methodology employed in this study. As such, the research design, procedures, population and sample, instrumentation, data collection, and data analysis were presented.

The independent variables in this study were student learning styles, critical thinking dispositions, motivation scores, and student self-efficacy. The dependent variables were student achievement scores and student attitudes. Achievement pre-test scores, gender, computer proficiency, employment, experience, and grade point average were also included as antecedent variables. The design of this study was identified as causal-comparative. The attributes of this design were discussed. Threats to validity were also outlined.

This chapter presents the findings obtained by this study. The results address the objectives and hypotheses of this study in determining the influence of learning styles, self-efficacy, motivation, and critical thinking dispositions on student achievement and attitudes when an illustrated web lecture is used as the learning activity in an online-learning environment.

The sample used in this study consisted of students enrolled in the online section of FOS 2001 *Man's Food,* from the 2003 summer semester (*n*=322). As outlined in Chapter 3, data for this study were collected at four points. The first data collection point consisted of a self-efficacy instrument, a critical thinking dispositions instrument, a motivation instrument, and a demographics instrument. This instruments were administered online using a web-based form to collect the data. As seen in Table 4-1, the response rate for these instruments was 83.2% (*n* = 268).

Table 4-1 Response Rates for Data Collection Components

Data Collection Component	*n*	Response Rate
Self-efficacy Instrument	268	83.2%
Critical Thinking Disposition Instrument	268	83.2%
Motivation Instrument	268	83.2%
Demographics Instrument	268	83.2%
Achievement Pre-Test	236	73.3%
Achievement Post-Test	322	100.0%
Learning Styles Instrument	256	79.5%
Attitudes Instrument	256	79.5%

The second data collection point from this study was the Achievement Pre-Test. This instrument was also administered as a web-based form. Data were collected from 260 participants. However, 24 participants responded after the treatment had begun. Therefore, usable results were obtained from 236 participants for a 73.3% response rate (see Table 4-1). The instructor of the course administered the Achievement Post-Test

face-to-face. All 322 participants competed this instrument for a 100% response rate (see Table 4-1). The final data collection point for this study consisted of a learning styles instrument and an attitudes instrument. These instruments were administered as web-based forms. As seen is Table 4-1, the response rate for each of these questionnaires was 79.5% (n = 256).

In instances where a participant did not respond to an individual item that was part of an instrument, the missing item was replaced with the mean of that participant's remaining items in that instrument (DeVaus, 1990). In instances where participants did not respond to an entire instrument, or a particular demographic question, the variable was coded as missing and excluded from analysis that involved that variable.

Prior to data analysis, post hoc reliability analysis was established for each instrument that was created or modified by the researcher. Instruments measuring constructs through Likert-type items were tested for internal consistency using Cronbach's alpha. These include the self-efficacy, motivation, critical thinking dispositions, and attitude instruments. The achievement pre-test consisted of data with items measured as right/wrong. This instrument was analyzed for reliability using the Kuder-Richardson 20 formula. Data for the achievement post-test consisted only of final scores. As such, reliability analysis was not performed. However, the achievement post-test was a parallel form to the achievement pre-test, so the reliability of the achievement post-test would be similar to the achievement pre-test.

The self-efficacy and attitude instruments yielded alpha values of r = .86 and r = .85 respectively (see Table 4-2). The reliability coefficient critical thinking dispositions instrument was r = .88. Analysis for individual constructs within the instrument yielded

alphas for the engagement construct of $r = .90$ and the innovativeness construct of $r = .78$. However, the maturity construct had low reliability. As such, the item "when deciding what or who to believe, I consider how my own biases affect my opinion" was dropped from the instrument to raise that alpha to .59. A similar issue arose in an earlier version of this instrument used by Ricketts (2003). Likewise, reliability analysis for the motivation instrument indicated problems with two items, "I think of the questions I cannot answer" and "I think of how poorly I am doing." Upon discarding these items, reliability analysis yielded an alpha of .74. Reliability analysis for the achievement pre-test indicated an acceptable reliability ($r = .82$).

Table 4-2 Post-Hoc Instrument Reliability

Instrument	Reliability
Self-Efficacy	.86
Motivation	.74
Critical Thinking Disposition (EMI)	.88
Engagement Construct	.90
Maturity Construct	.59
Innovativeness Construct	.78
Attitudes	.85
Achievement Pre-Test	.82[a]

Note. [a]Kuder-Richardson 20. All other reliabilities determined by Cronbach's alpha.

Objective One

Describe the Learning Styles, Critical Thinking Dispositions, Self-efficacy, Motivation, and Demographic Characteristics of Participants in this Study.

Age and Gender

Of the 322 participants in the study, 49.4% were female ($n = 159$). Fifty-five participants (17.1%) either did not respond to this question or had missing data. The ages of participants ranged from 17 to 53 (see Figure 4-1). The average age of participants was 21.13 years old ($SD = 3.93$, $n = 267$). The median age was 20.

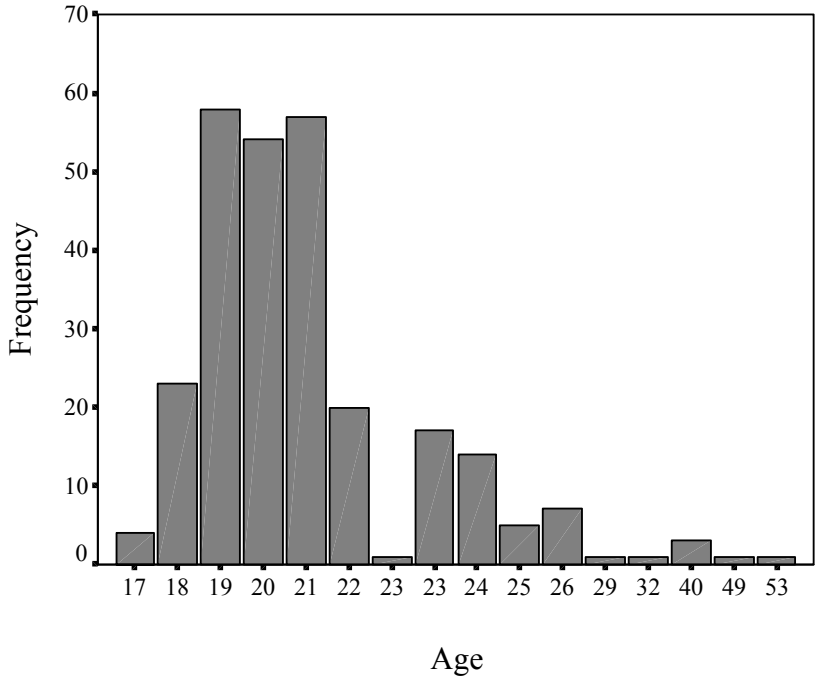

Figure 4-1 Distribution of Participant Age

Academic College

Participants in this sample represented 11 different academic colleges (see Table 4-3). The greatest percentage of the participants was from the College of Liberal Arts and Sciences (*n* = 104, 32.3%). Fifty-six participants (17.4%) were from the College of Business Administration. An additional 26 participants (8.1%) were from the College of Agricultural and Life Sciences. Other colleges represented in this sample included: Journalism and Communications (*n* = 18, 5.6%); Engineering (*n* = 16, 5.0%); Design, Construction, and Planning (*n* = 9, 2.8%); Fine Arts (*n* = 8, 2.5%); Nursing (*n* = 8, 2.5%); Health and Human Performance (*n* = 7, 2.2%); Education (*n* = 1, .3%); and Pharmacy (*n* = 1, .3%). Nine participants (2.8%) indicated that they had not yet declared a college, and five participants (1.6%) indicated that they were enrolled in none of the above colleges.

Fifty-four participants (16.8%) did not respond to the first questionnaire, which contained the demographics instrument.

Table 4-3 Academic College of Participants

College	*n*	%
Liberal Arts and Sciences	104	32.3
Business Administration	56	17.4
Agricultural and Life Sciences	26	8.1
Journalism and Communications	18	5.6
Engineering	16	5.0
Design, Construction, and Planning	9	2.8
Fine Arts	8	2.5
Nursing	8	2.5
Health and Human Performance	7	2.2
Education	1	.3
Pharmacy	1	.3
Natural Resources	0	0
Undeclared	9	2.8
Other	5	1.6
Not Indicated or Missing	54	16.8

Grade Point Average

Self reported grade point averages (GPA) ranged from 1.95 to 4.00 (see Figure 4-2). The mean GPA was 3.17 (*SD* = .52).

Previous Distance Experience

The number of distance or online classes that participants have previously taken ranged from 0 to 15 (see Figure 4-3). The mean of this distribution was 1.72 (*SD* = 2.35, *n* = 249). The median number of courses was one. Almost 40% of the participants in this study (*n* = 98) had taken no previous online or distance education courses. An additional 47% (*n* = 116) had taken under three courses.

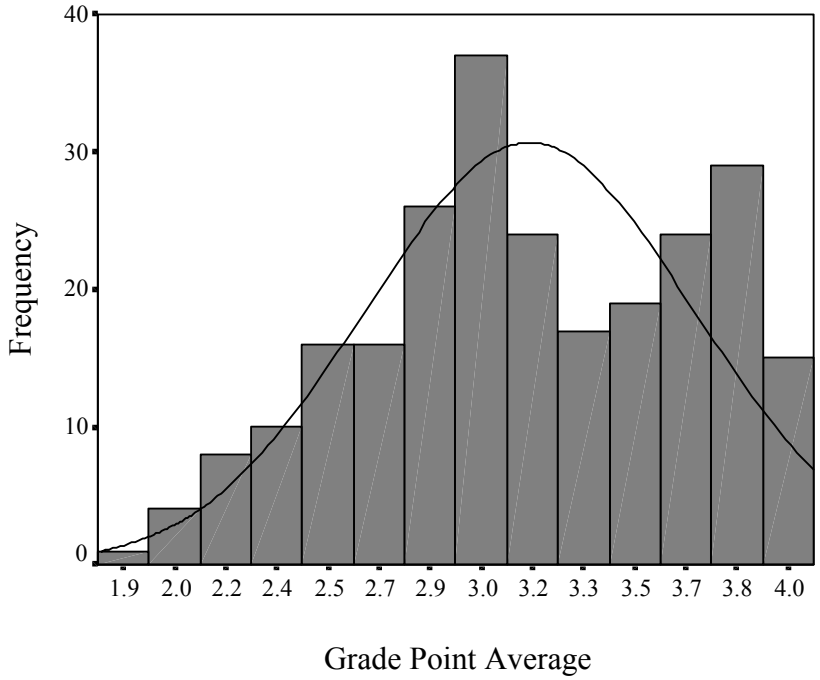

Figure 4-2 Distribution of Student Grade Point Averages

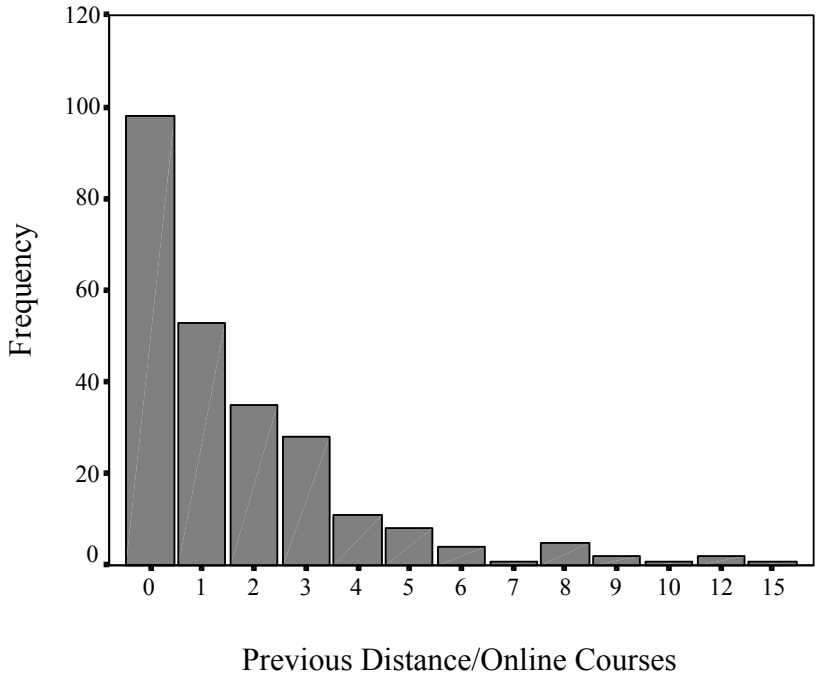

Figure 4-3 Distribution of Participant Previous Distance/Online Courses

Computer Proficiency

Participants in this study were asked to indicate their self-perceived computer proficiency on a scale from 0 to 100. Responses ranged from 5 to 100 (see Figure 4-4). The mean was 78.77 (*SD* = 14.30, *n* = 267).

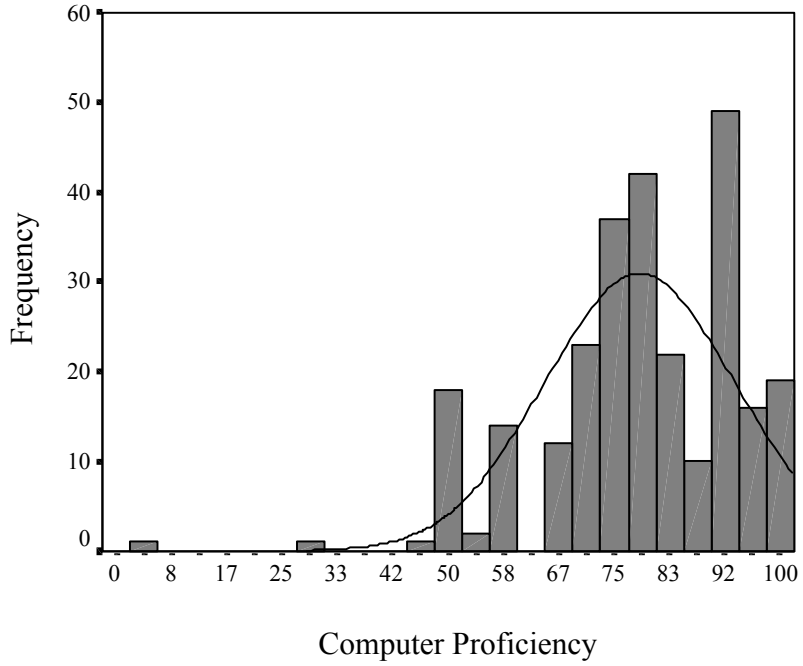

Figure 4-4 Distribution of Participant Computer Proficiency

Employment

Participants were asked to indicate if they had a job, and if so, to list the number of hours worked per week. Nearly half of the participants (*n* = 160, 49.7%) were employed. The remaining participants were either unemployed (*n* = 107, 33.2%) or did not answer this question (*n* = 55, 17.1%).

Of the employed participants, 130 indicated that they worked from 5 to 70 hours per week (see Figure 4-5). The mean hours worked per week was 27.97 (*SD* = 12.14). The median number of hours worked was 27.

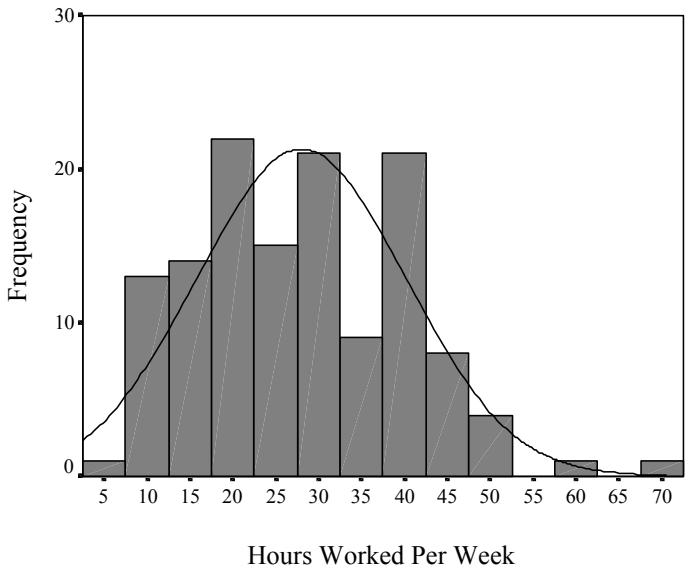

Figure 4-5 Distribution of Hours Worked by Participants

Self-Efficacy

Self-efficacy scores were determined by summing the values for the 17 items that composed the instrument. Self-efficacy scores were calculated for 268 participants. The mean score was 68.35 (*SD* = 8.64). Scores ranged from 26 to 85 (see Figure 4-6).

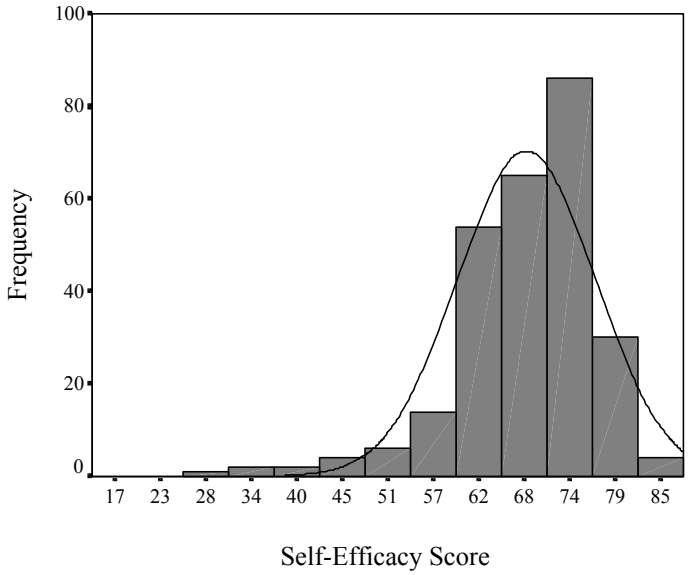

Figure 4-6 Distribution of Participant Self-Efficacy Scores (Possible Range = 17 to 85)

Means of individual items in the self-efficacy instrument ranged from 3.34 to 4.60 for positively worded items (see Table 4-4). The two negatively worded items had means of 2.62 and 2.99. These two items were reverse coded to calculate the self-efficacy score.

Table 4-4 Self-Efficacy Instrument Summary of Individual Items

Item	*M*	*SD*
I try harder at tasks I enjoy.	4.60	.79
I expect to succeed.	4.56	.77
When I fail at a task, I want to know what I did wrong.	4.47	.82
I believe that I can successfully accomplish any class assignment or task.	4.37	.84
My success in completing an assignment is due to the amount of effort I put into it.	4.23	.91
I can accomplish any task I want to if I have enough time.	4.23	.88
I like to have my teacher tell me if I'm doing well on an assignment, so that I'll know that I'm doing it right.	4.15	.97
When I see a classmate accomplishing a task, I know that I can too.	4.10	.97
When I fail at a task, I try a different strategy to accomplish it.	4.04	.81
When I fail at a task, I try again.	4.04	.89
When I fail at a task, I try harder.	4.00	.93
I will complete an assignment no matter how hard it is.	4.00	.93
I have control over the outcome of all of my educational experiences.	3.96	.98
It is easier for me to complete classwork if I set short-term goals.	3.88	.97
My success in completing an assignment is due primarily to my intelligence.	3.34	1.03
I know when to give up and quit trying.	2.99[a]	1.10
If I feel anxious while working on any classwork, I know it's because I don't feel capable of doing it.	2.62[a]	1.09

Note. Rating Scale was 1 = Strongly Disagree to 5 = Strongly Agree.
[a]Negatively worded items. Coding was reversed when computing self-efficacy scores.

Motivation

Motivation scores were determined by the individual values for the seven items that composed the instrument. Data were collected from 268 participants. The mean motivation score was 29.42 (*SD* = 3.67). Scores ranged from 14 to 35 (see Figure 4-7).

Individual items had means that ranged from 3.86 to 4.59 (see Table 4-5). The possible range for motivation scores was 7 to 35.

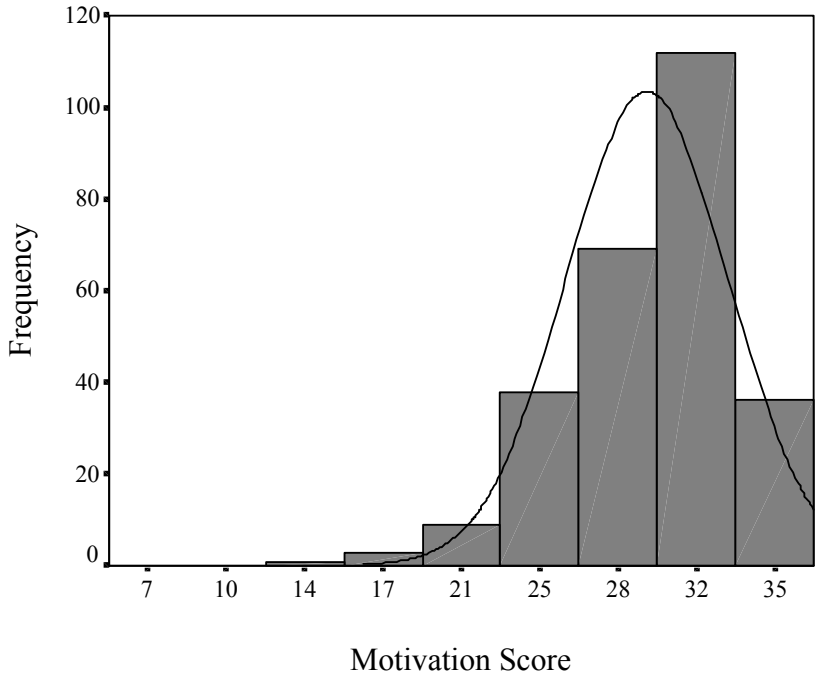

Figure 4-7 Distribution of Participant Motivation Scores (Possible Range = 7 to 35)

Table 4-5 Motivation Instrument Summary of Individual Items

Item	*M*	*SD*
I prefer course material that arouses my curiosity.	4.59	.67
I expect to do well in this class.	4.58	.68
Studying appropriately, I can learn the material.	4.54	.69
I want to get better grades than other students.	3.97	1.06
I am satisfied with trying to understand content.	3.97	.85
I am interested in the content area of this course.	3.91	.91
Course material is useful to learn.	3.86	.90

Note. Rating Scale was 1 = Strongly Disagree to 5 = Strongly Agree.

Critical Thinking Dispositions

Critical Thinking Dispositions were calculated by summing the individual values for the 25 items on the instrument for the 268 participants who completed this instrument. The mean score for Critical Thinking Dispositions was 94.67 (*SD* = 11.39). Scores

ranged from 44 to 121 (see Figure 4-8). The possible range for critical thinking disposition scores was 25 to 125.

Individual items from the Critical Thinking Dispositions were also examined (see Table 4-6). Positively worded items had means that ranged from 3.26 to 4.52. Negatively worded items ranged from 2.22 to 3.16. Negatively worded items were reverse coded to calculate the critical thinking score.

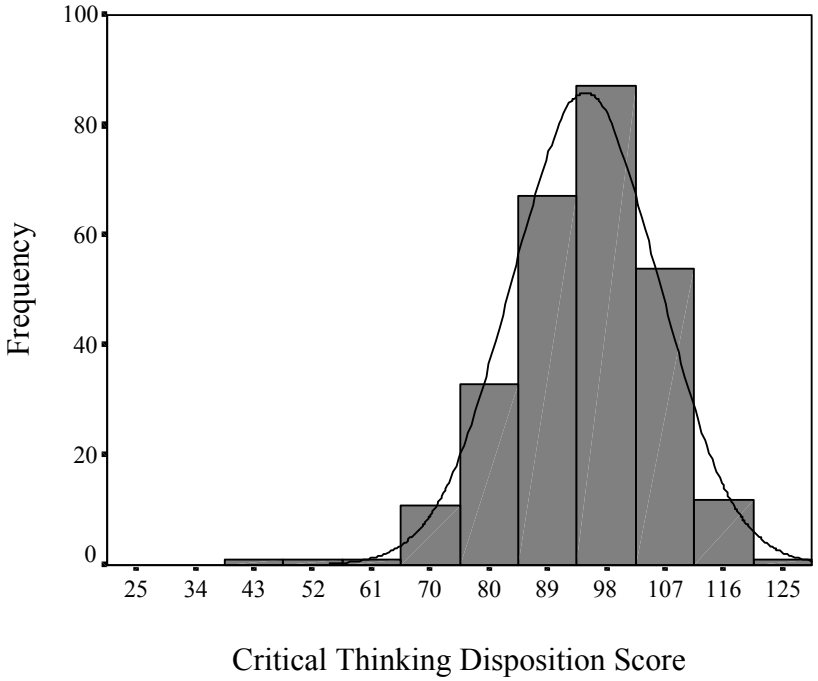

Figure 4-8 Distribution of Participant Critical Thinking Disposition Scores (Possible Range = 25 to 125)

Individual index scores were calculated for each of the engagement, maturity, and innovativeness constructs by standardizing the grand mean for each construct to a scale of 100. Index scores from the Engagement Construct ranged from 29.09 to 100.00 (see Figure 4-9). The mean was 78.25 (*SD* = 11.98). The Maturity Construct yielded index scores from 34.29 to 97.14 (see Figure 4-10). The mean of this construct was 68.34 (*SD* =

11.25). The Innovativeness Construct had scores that ranged from 31.43 to 100.00 (see Figure 4-11). The mean was 79.17 (*SD* = 11.46).

Table 4-6 Critical Thinking Disposition Instrument Summary of Individual Items

Construct	Item	*M*	*SD*
E	I am interested in many issues.	4.18	.78
E	I am confident that I can reach a reasonable conclusion.	4.08	.86
E	I am able to relate to a wide variety of issues.	4.04	.86
E	I am able to apply my knowledge to a wide variety of issues.	4.02	.78
E	I enjoy finding answers to challenging questions.	3.97	.94
E	I am a good problem solver.	3.95	.86
E	I keep on working on things until I get them right.	3.93	.86
E	I look for opportunities to solve problems.	3.90	.87
E	I ask good questions when trying to clarify a solution.	3.68	.87
E	I present issues in a clear and precise manner.	3.67	.84
E	I am able to explain things clearly.	3.62	.82
M	Most problems have many solutions that would work to solve the problem.	3.85	.88
M	I can quickly judge people and decide whether or not I can get along with them.	3.16[a]	1.12
M	I make quick decisions and avoid asking questions that may complicate the process.	2.80[a]	1.09
M	I am not likely to change my opinions even when I am given new information that might conflict with them.	2.64[a]	.97
M	I know I have biases and if other people can't accept that it is their problem.	2.68[a]	1.11
M	When someone disagrees with me I usually tune him or her out.	2.42[a]	.95
M	Most issues have one right answer.	2.22[a]	1.05
I	It is important to be well informed.	4.52	.74
I	It is important for me to have a deep understanding of more than one issue.	4.22	.85
I	I enjoy learning even when I am not in school.	4.18	.79
I	I search for the truth even when it makes me uncomfortable.	3.87	.90
I	I will go out of my way to find the right answers to a problem.	3.85	.87
I	I enjoy solving problems.	3.81	.89
I	I ask lots of questions in a learning environment.	3.26	1.02

Note. E = Engagement Construct, M = Maturity Construct, and I = Innovativeness Construct. Rating Scale was 1 = Strongly Disagree to 5 = Strongly Agree.
[a]Negatively worded items. Coding was reversed when computing critical thinking disposition scores.

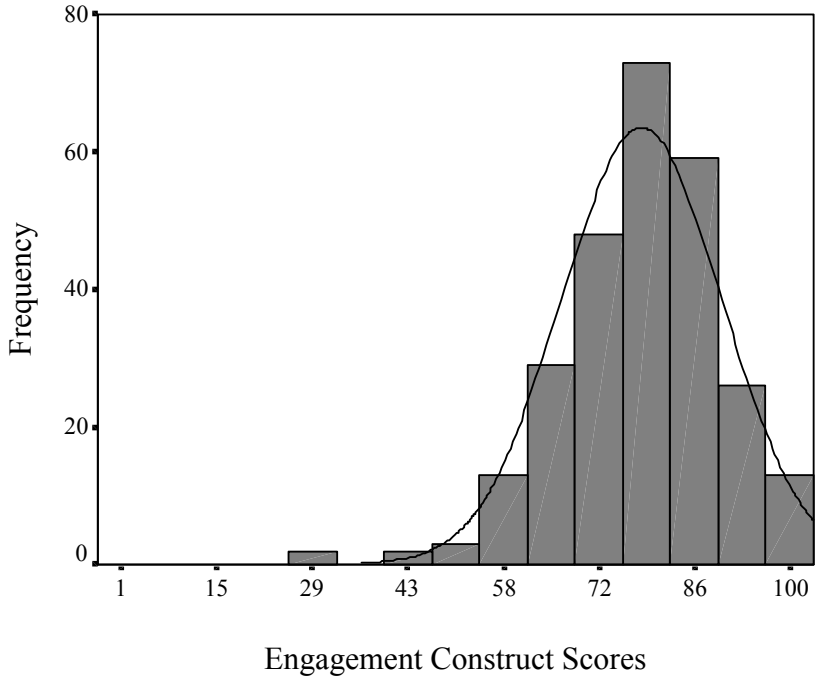

Figure 4-9 Distribution of Participant Engagement Construct Scores (Indexed to a scale of 100)

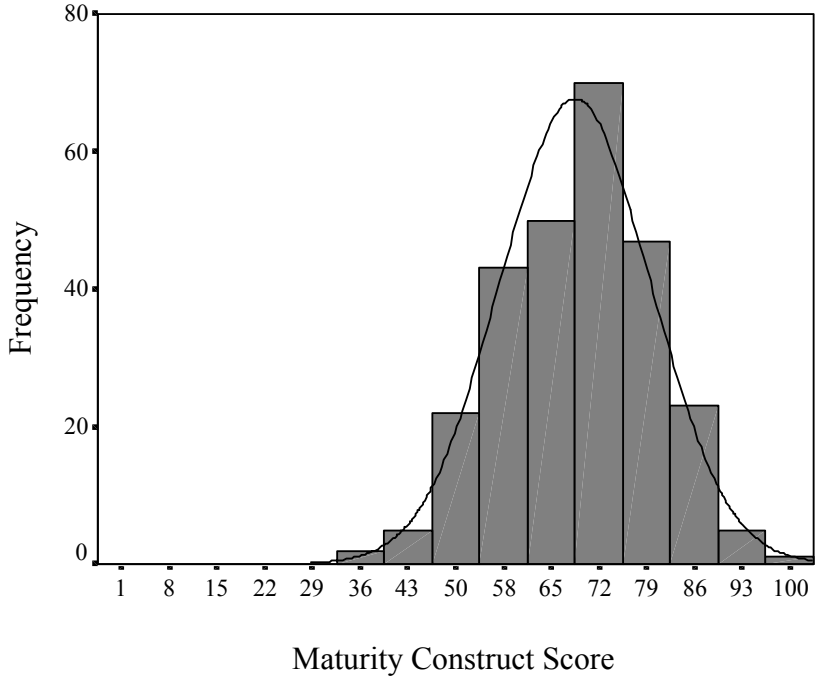

Figure 4-10 Distribution of Participant Maturity Construct Scores (Indexed to a scale of 100)

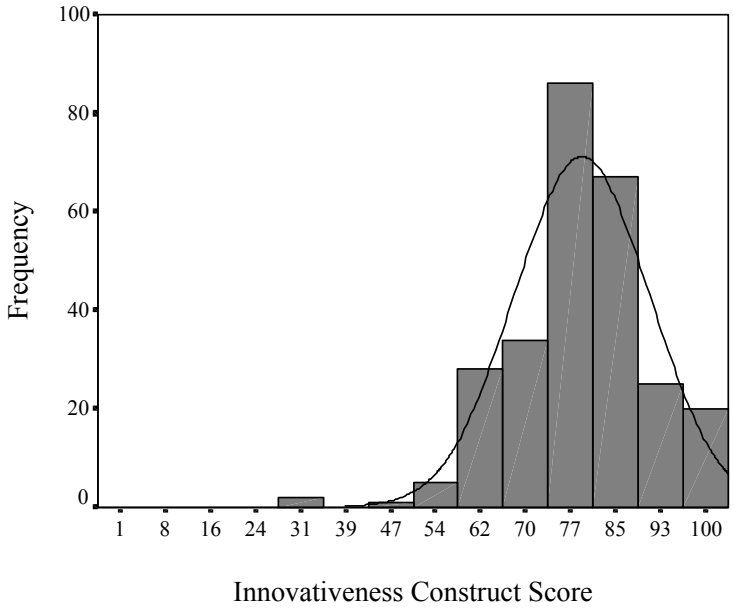

Figure 4-11 Distribution of Participant Innovativeness Construct Scores (Indexed to a scale of 100)

Learning Style

The Gregorc Style Delineator yields four scores for each participant, one each for Concrete Sequential (CS), Abstract Sequential (AS), Abstract Random (AR), and Concrete Random (CR) constructs. The possible range for each construct is from 10 to 40. Usable data were collected from 245 participants. The mean CS score was 25.78 (*SD* = 5.22). CS scores ranged from 13 to 40 (see Table 4-7 and Figure 4-12). The mean AS score was 24.04 (*SD* = 4.51), with a range was of 14 to 36 (see Figure 4-13). The AR mean score was 24.65 (*SD* = 5.20). AR scores ranged from 12 to 36 (see Figure 4-14). The mean CR score was 25.50 (*SD* = 4.75), with a range of 11 to 37 (see Figure 4-15).

Table 4-7 Learning Style Descriptive Statistics

Learning Style	Minimum	Maximum	*M*	*SD*
Concrete Sequential	13	40	25.78	5.22
Abstract Sequential	14	36	24.04	4.51
Abstract Random	12	36	24.65	5.20
Concrete Random	11	37	25.50	4.75

Note. The maximum possible range was 10 to 40.

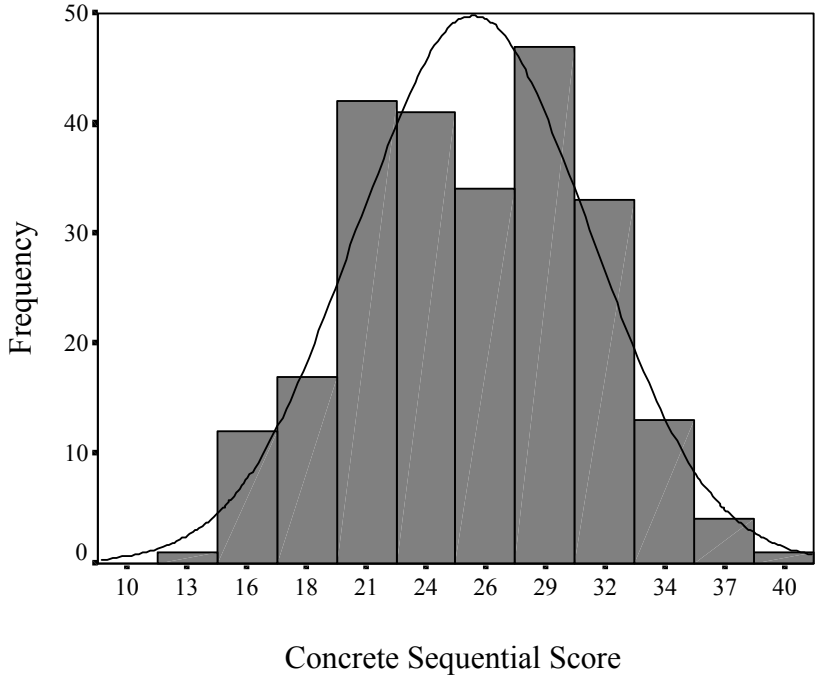

Figure 4-12 Distribution of Concrete Sequential Scores (Possible Range = 10 to 40)

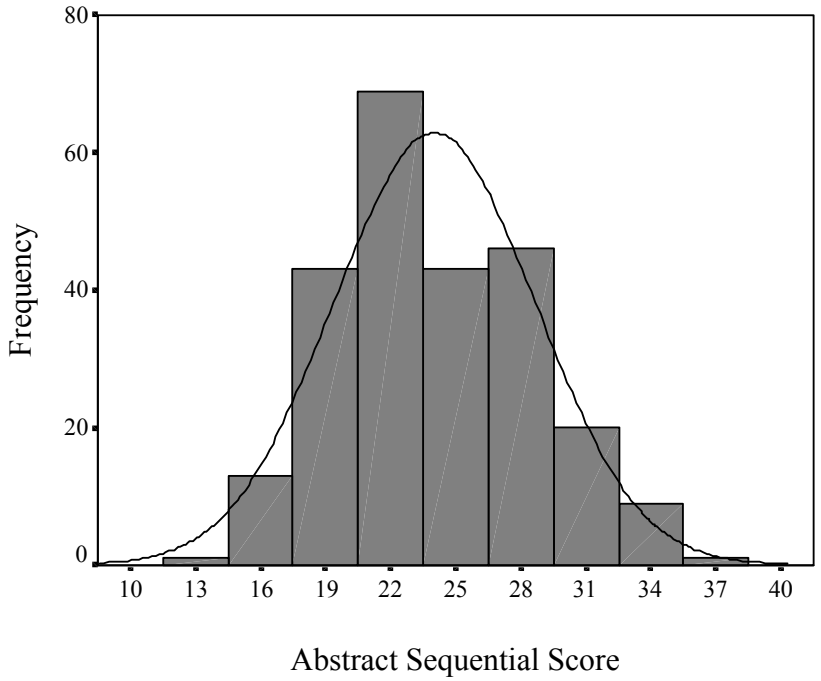

Figure 4-13 Distribution of Abstract Sequential Scores (Possible Range = 10 to 40)

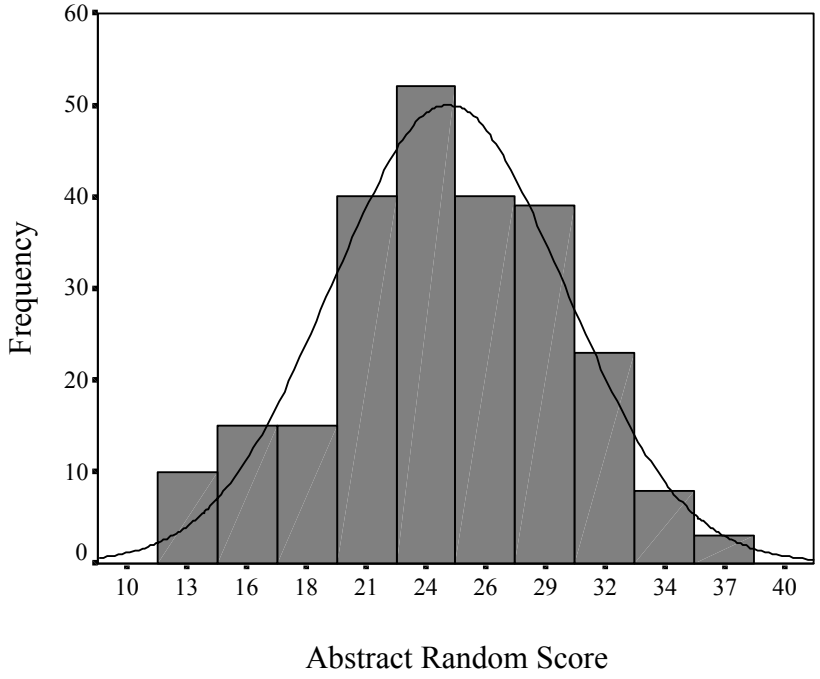

Figure 4-14 Distribution of Abstract Random Scores (Possible Range = 10 to 40)

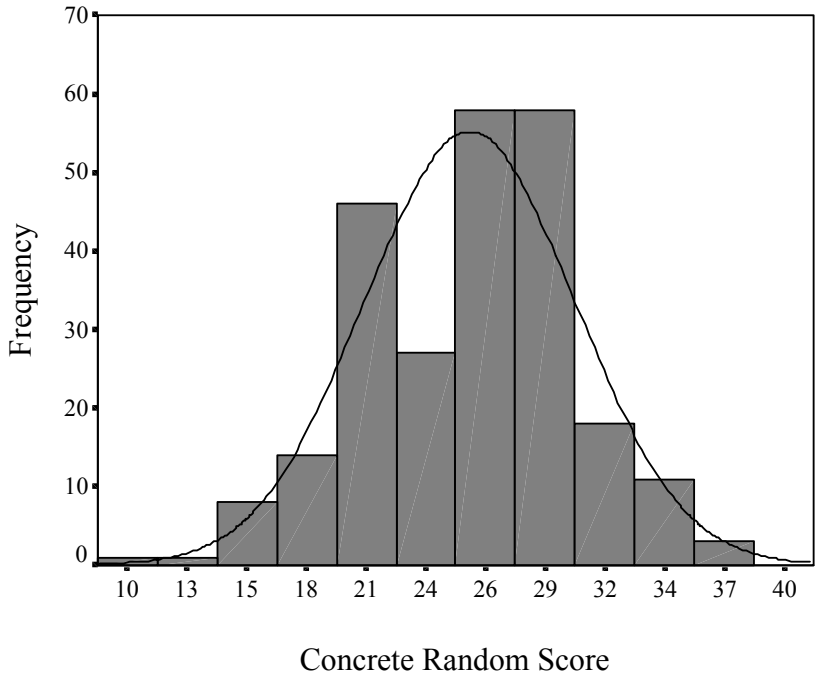

Figure 4-15 Distribution of Concrete Random Scores (Possible Range = 10 to 40)

Participants were categorized as CS, AS, AR, or CR, based on their highest score for each individual construct. Having equal scores in more than one learning style has been handled in numerous ways (Duncan, 1996; Ross, Drysdale, & Shulz, 2001; Ross & Schulz, 1999; Swearingen, 1998). Swearingen (1998) created multiple learning style categories, such as CS-AS. Other researchers, such as Ross et al. (2001), have used only the four learning styles of CS, AS, AR, and CR by allowing a computer to randomly assign a participant to one of the categories in which they tied. However, classification into one of the four learning styles was desired for this study. In doing so, a more methodical approach to breaking ties was used. For example, if a participant had equal scores in two learning styles, the highest score on the common component was used to break the tie (i.e. If a participant had equal scores for CS and AS, the scores from CR and AR would be examined. If the CR score was higher, the participant was classified as CS). If a participant had equal scores in constructs that had no common component, such as CS and AR, the participant was classified as having no dominant learning style.

Of the 245 participants with valid learning style scores, 82 (33.5%) were classified as CS learners (see Figure 4-16). Sixty-two participants (25.3%) were classified as CR learners, 52 participants (21.2%) were classified as AR learners, and 38 participants (15.5%) were classified as AS learners. Eleven participants (4.5%) exhibited no dominant learning style.

Achievement

The Achievement Post-Test determined achievement. The maximum possible score was 100. Pre-Test scores were collected from 236 participants and ranged from 15 to 75 (see Figure 4-17). The mean was 34.36 (*SD* = 10.28). Post-Test scores were collected from all 322 participants. Scores ranged from 23 to 74 (see Figure 4-18). The

mean score was 55.24 (*SD* = 9.20). Gain scores were calculated for 236 participants and ranged from –11 to 53 (see Figure 4-19). The mean gain score was 21.90 (*SD* = 11.69).

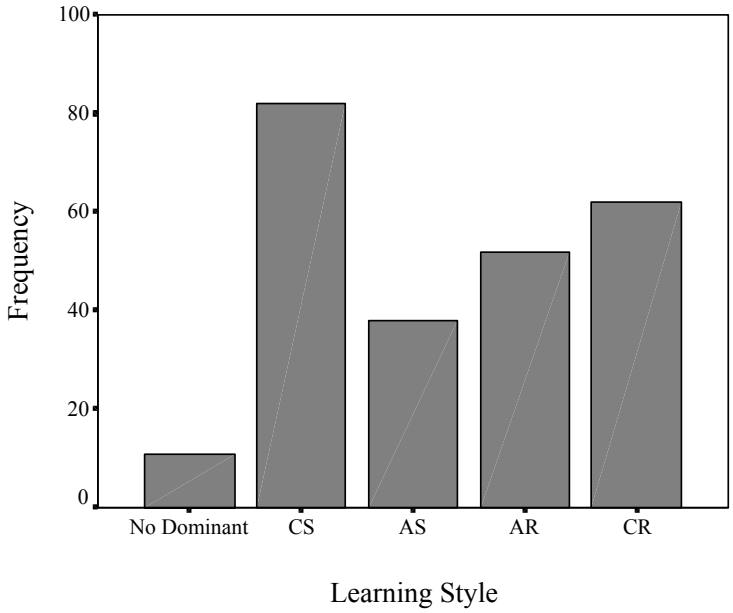

Figure 4-16 Distribution Learning Styles by Category

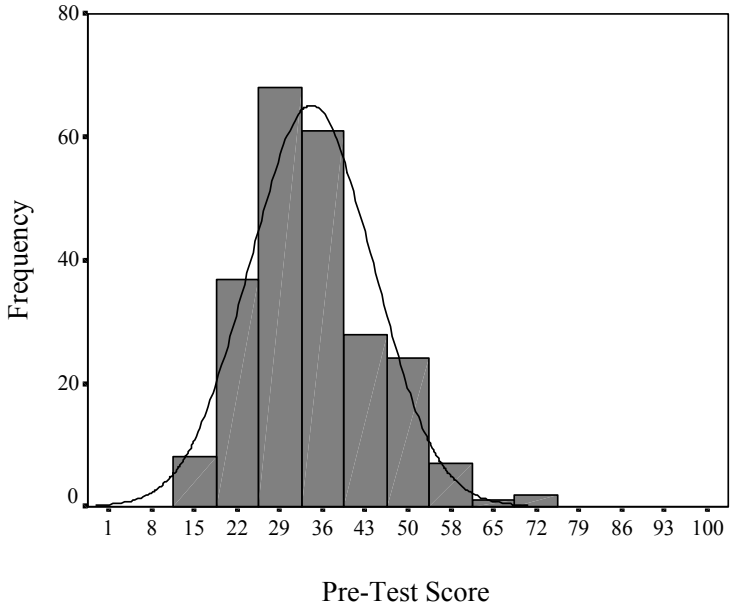

Figure 4-17 Distribution of Participant Achievement Pre-Test Scores

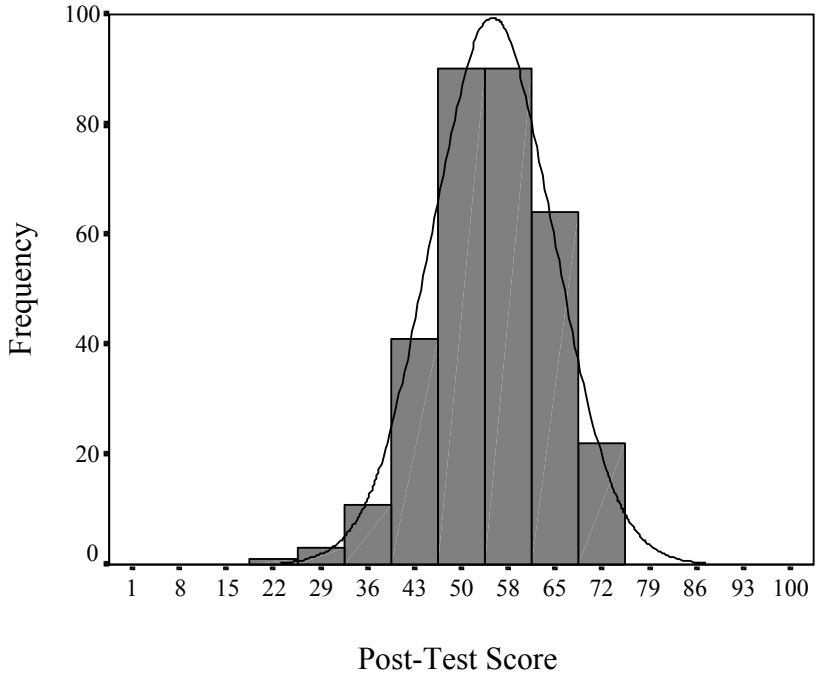

Figure 4-18 Distribution of Participant Achievement Post-Test Scores

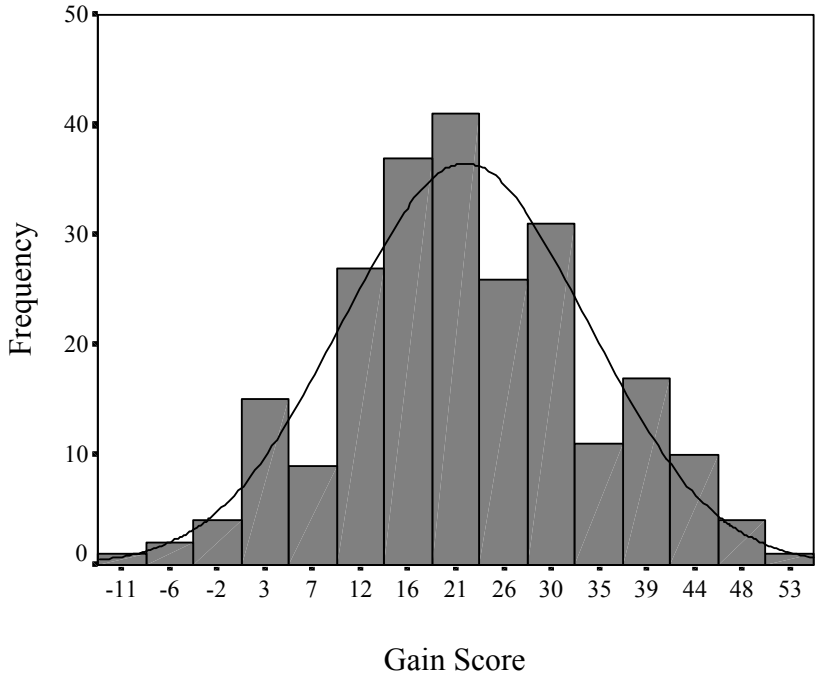

Figure 4-19 Distribution of Participant Achievement Gain Scores

Attitudes

Attitudes scores were determined by summing the individual values for the 11 items that composed the attitudes instrument. Data were collected from 256 participants. Scores ranged from 15 to 55 (see Figure 4-20). The mean score was 39.24 (*SD* = 8.44).

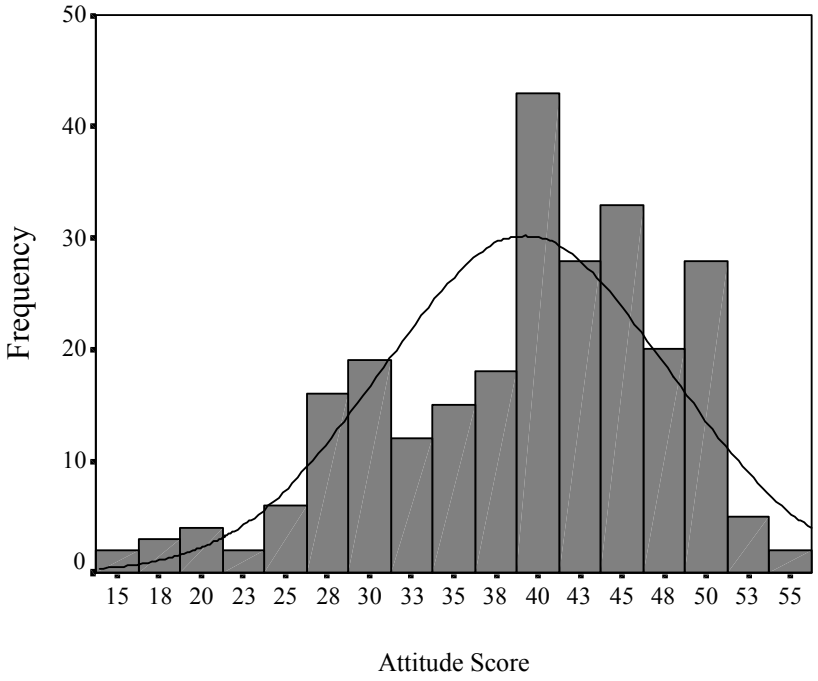

Figure 4-20 Distribution of Participant Attitude Scores

Individual item means ranged from 3.00 to 4.40 for the positively worded items (see Table 4-8). The two negatively worded items had means of 2.58 and 2.79. These two items were reverse coded to calculate the attitude score.

Relationships Between Variables

As part of the description of the variables in this study and prior to any inferential analysis, variables were examined for correlations. The magnitude of the correlations is discussed using terminology proposed by Miller (1994). Correlations between .01 and .09 are negligible, correlations between .10 and .29 are low, correlations between .30 and .49

are moderate, correlations between .50 and .69 are substantial, correlations between .70 and .99 are very high, and a correlation of 1.0 is perfect. Pearson correlations were used for continuous data and point biserial correlations were used for dichotomous data.

Table 4-8 Attitude Instrument Summary of Individual Items

Item	*M*	*SD*
Learning through web-based lecture is convenient.	4.40	.92
Web-based lectures allow me to control the pace of my learning.	4.20	1.05
I would enroll in another web-based lecture course.	3.81	1.24
I would recommend web-based lecture courses to my friends.	3.73	1.18
I enjoyed learning from the web-based lecture lessons.	3.67	1.22
Web-based lecture lessons should be utilized more often to deliver instruction.	3.56	1.17
Web-based lecture courses provide me with learning opportunities that I otherwise would not have.	3.18	1.26
I feel more isolated as a student when I take courses that use web-based lectures.	3.08	1.32
I prefer web-based lectures to traditional classroom instruction.	3.00	1.27
Learning through web-based lectures is boring.	2.79[a]	1.21
I would not take web-based lecture courses if I had other means of acquiring course credit.	2.58[a]	1.30

Note. Rating Scale was 1 = Strongly Disagree to 5 = Strongly Agree.
[a]Negatively worded items. Coding was reversed when computing attitude score.

As seen in Table 4-9, substantial correlations were discovered between self-efficacy and critical thinking disposition (r = .689), Concrete Sequential learning style and Concrete Random learning style (r = -.641), and Abstract Sequential learning style with Abstract Random learning style (r = -.626).

Moderate correlations were discovered between self-efficacy and motivation (r = .485), motivation and critical thinking disposition (r = .452), Concrete Sequential learning style and Abstract Random learning style (r = -.475), and Abstract Sequential learning style with Concrete Random learning style (r = -.334). As seen in Table 4-9, numerous low correlations were observed

Table 4-9 Correlations Between Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Computer Score	--	-.086	-.026	.087	.089	.140*	.047	-.114	.005	.033	.092	-.046	.040	.201*
2. GPA		--	-.083	.001	.053	-.070	-.044	-.001	.013	.006	-.025	.008	.077	.088
3. Age			--	.143*	.035	.025	-.021	.060	.050	-.086	-.027	.049	.033	.035
4. Previous Courses				--	-.007	-.047	.005	.100	-.074	.022	-.084	-.004	.026	.037
5. Self-Efficacy					--	.689**	.485**	.018	-.064	-.053	.093	.087	.198**	.120
6. CT Disposition						--	.452**	-.108	.061	-.068	.130*	.050	.133*	.073
7. Motivation Score							--	.056	-.087	.021	-.011	.157*	.252**	.144*
8. LS – CS Score								--	.077	-.475**	-.641**	.010	.070	.004
9. LS – AS Score									--	-.626**	-.334**	.001	-.003	-.051
10. LS – AR Score										--	.017	-.002	-.018	.012
11. LS – CR Score											--	-.006	-.060	.026
12. Pre-Test Score												--	.256**	.146*
13. Post-Test Score													--	.180**
14. Attitude Score														--

Note. * p<.05, ** p<.001. CT = Critical Thinking, LS = Learning Style, CS = Concrete Sequential, AS = Abstract Sequential, AR = Abstract Random, CR = Concrete Random.

Dichotomous variables were also examined for correlations with other variables. For data analysis purposes, in the gender variable, females were coded higher than males. As such, a positive correlation indicated that the variable increased if the participant was a female. For the employment variable, a 'Yes' response was coded higher that a 'No' response. As such, a positive correlation indicated that the variable increased if the participant was employed.

As seen in Table 4-10, low correlations were discovered between gender and computer proficiency score (r = -.149), gender and self-efficacy score (r = -.148), gender and critical thinking disposition score (r = -.117), and gender with critical thinking engagement score (r = -.148). Other low correlations included employment and grade point average (r = -.166) and employment with age (r = .163).

Table 4-10 Point Biserial Correlations Between Variables

Variable	Gender(M/F)[1]	Employment(N/Y)[2]
Computer Score	-.149*	-.044
Grade Point Average	.023	-.166*
Age	-.049	.163**
Previous Courses	.044	-.011
Self-Efficacy Score	-.148*	.067
Critical Thinking Disposition Score	-.117	.069
Critical Thinking – Engagement Construct	-.148*	.079
Critical Thinking – Maturity Construct	.005	-.019
Critical Thinking – Innovativeness Construct	-.094	.081
Motivation Score	-.052	-.017
Concrete Sequential Score	-.025	-.082
Abstract Sequential Score	-.034	-.055
Abstract Random Score	.057	.061
Concrete Random Score	-.002	.069
Pre-Test Score	-.041	-.053
Post-Test Score	-.019	-.051
Attitude Score	.046	-.099

Note. * = $p < .05$; ** = $p < .01$; [1]Females coded higher; [2]Employment = Yes coded higher

Objective Two

Describe the Variance in Student Achievement Attributed to Learning Styles, Critical Thinking Dispositions, Self-efficacy, Motivation, and Student Demographic Characteristics.

Backwards regression was used to select the best model for predicting achievement post-test scores using learning styles, critical thinking dispositions, self-efficacy, motivation, student demographic characteristics, and achievement pre-test scores. This procedure was used because it utilizes all available variables to build a model that consists of only variables that contribute significantly to predicting the dependent variable (Agresti & Finlay, 1997). Motivation and achievement pre-test scores yielded the best model in predicting achievement post-test scores. Regression analysis revealed that a liner combination of motivation scores and achievement pre-test scores significantly predicted achievement post-test scores, F (2,233) = 15.13, $p < .001$. R^2 for the model was .115, adjusted R^2 was .107. Table 4-11 shows the regression coefficients for this model. Achievement pre-test scores ($t = 3.531$, $p < .01$) and motivation scores ($t = 3.610$, $p < .01$) contributed significantly ($\alpha = .05$) to predicting achievement post-test scores. These two variables accounted for 10.7% of the variance in achievement post-test scores.

Table 4-11 Backward Regression Analysis to Predict Achievement Post-test Scores

Variable	*B*	*SE*	*β*	*t*	*p*
Constant	33.054	4.742		6.970	< .01
Achievement Pre-test Score	.188	.053	.220	3.531	< .01
Motivation Score	.565	.157	.225	3.610	< .01

Objective Three

Describe the Variance in Student Attitudes Attributed to Learning Styles, Critical Thinking Dispositions, Self-efficacy, Motivation, and Student Demographic Characteristics.

Backwards regression was used to select the best model for predicting attitude scores using learning styles, critical thinking dispositions, self-efficacy, motivation, and student demographic characteristics. Computer proficiency score and motivation score yielded the best model in predicting attitude scores. Regression analysis revealed that a linear combination of the computer proficiency scores and motivation scores significantly predicted attitude scores, F (2,253) = 7.78, p = .001. R^2 for the model was .058, adjusted R^2 was .050. Table 4-12 shows the regression coefficients for this model. Computer proficiency scores (t = 3.153, p = .002) and motivation scores (t = 2.157, p = .032) contributed significantly (α = .05) to predicting attitude scores. These two variables accounted for 5% of the variance in attitude scores.

Table 4-12 Backward Regression Analysis to Predict Attitude Scores

Variable	*B*	*SE*	*β*	*t*	*p*
Constant	21.457	4.846		4.428	<.001
Computer Proficiency Score	.114	.036	.193	3.153	.002
Motivation Score	.299	.139	.132	2.158	.032

Hypothesis Tests

The dependent variables in this study were attitudes toward illustrated web lecture (measured by an attitude score) and achievement (indicated by post-test score). Both of these variables were interval data. Four independent variables were used in this study: Critical thinking disposition, self-efficacy, motivation, and learning styles. Critical thinking disposition, self-efficacy, and motivation were interval data. Learning styles were categorical data. Covariates were chosen based on their correlation with the

dependent variables (Ary, Jacobs, & Razavieh, 2002; Stevens, 1992). Based on the correlation analysis reported in Table 4-9, computer proficiency and pre-test scores were the only covariates significantly correlated with the dependent variables. These data were also interval data.

The null hypothesis of no difference in achievement and attitudes based on learning styles in the presence of student demographic variables, was tested using a Multivariate Analysis of Covariance (MANCOVA) procedure. This procedure is appropriate when determining differences between categorical independent variables on multiple interval dependent variables while statistically controlling for other variables (Stevens, 1992). The test statistic used to test hypotheses when two dependent variables are included in the MANCOVA procedure is Hotelling's T^2, which follows an F distribution. Before running the MANCOVA procedure, several assumptions must be met. According to Stevens (1992), the assumptions of the MANCOVA procedure include homoscedasticity, and equal group variances. Homoscedasticity was tested using the Box's M procedure. This statistic follows the F distribution. A statistically significant F value indicates that that homoscedasticity is not met. Equal group variance was tested using Levene's test. This test also yields an F value, which if statistically significant indicates that group variances are unequal.

Hypotheses that involved interval independent variables (critical thinking dispositions, self-efficacy, and motivation) were tested using canonical correlation analysis. Canonical correlation analysis is the appropriate analysis to determine if a relationship exists between multiple interval independent variables and multiple interval dependent variables (Stevens, 1992). The test statistic used in this procedure is Wilk's λ,

which follows an *F* distribution. Warmbrod (2003) indicated that an assumption for inferential tests in the canonical correlation procedure is having a multivariate normal distribution. However, he goes further to indicate that canonical correlation analysis is robust to violations of this assumption.

Null Hypothesis One

There is No Difference in Student Achievement and Attitudes, Based on Learning Styles in the Presence of Student Demographic Characteristics.

This hypothesis was tested using the MANCOVA procedure. Attitudes and achievement gain scores were the dependent variables. Learning style category and computer proficiency scores were the independent variables. The assumptions for the MANCOVA procedure were met. The Box's M test was not significant ($p = .708$) and Levine's tests were also not significant ($p = .489$ and $p = .512$). Hotelling's T^2 for the effects of learning style on the dependent variables was 4.82, F (8,430) = .890, $p = .583$. The effect size was .011 and the power was .272. As such, the null hypothesis was not rejected.

Null Hypothesis Two

There is No Relationship Between Critical Thinking Disposition and a Linear Combination of Student Achievement and Attitudes in the Presence of Student Demographic Characteristics.

This hypothesis was tested using the canonical correlation procedure. Attitudes and achievement post-test scores were the dependent variables. Critical thinking disposition scores, computer proficiency scores, and achievement pre-test scores were the independent variables. Descriptive statistics and relationships between the variables can be seen in Table 4-13. As seen in Table 4-14, a significant relationship was found, Wilk's $\lambda = .890$, F (6,454) = 4.58 ($p < .01$). Therefore, the null hypothesis that there is no

relationship between critical thinking disposition and a linear combination of student achievement and attitudes in the presence of student demographic characteristics was rejected.

Table 4-13 Descriptive Statistics for Canonical Correlation Analysis Testing Critical Thinking Disposition

Variable	Correlations					*M*	*SD*
	Y_1	Y_2	X_1	X_2	X_3		
Dependent Variable Set							
Achievement Post-Test Score (Y_1)	--	.180	.133	.040	.256	55.24	9.20
Attitude Score (Y_2)		--	.073	.201	.146	39.24	8.44
Independent Variable Set							
Critical Thinking Score (X_1)			--	.140	.087	94.67	11.39
Computer Proficiency (X_2)				--	-.046	78.77	14.30
Achievement Pre-Test Score (X_3)					--	34.36	10.28

When examining the results of the canonical correlation, a linear combination of critical thinking score, computer proficiency score, and achievement pre-test score accounted for 6.4% of the variance in a linear combination of attitudes and achievement post-test score. Only the first canonical root was significant ($R^2_{c(1)} = .096$, $p < .01$). When examining the correlation of the independent variables to this root, achievement pre-test score is the most highly correlated ($r = .875$). According to Warmbrod (2003), any correlation greater than .3 is meaningful. As such, the correlations of critical thinking disposition ($r = .346$) and computer proficiency score ($r = .386$) to this canonical root are also worth noting.

Individual regressions were run as a follow-up to the canonical correlation procedure to better explain the contribution of critical thinking disposition score to attitudes and to achievement. The first regression used critical thinking disposition scores, computer proficiency scores, and achievement pre-test scores as independent

variables, with achievement post-test scores as the dependent variable. The combination of these independent variables explained 6.4% of the variance in achievement post-test score. As seen in Table 4-15, a significant relationship did not exist between critical thinking disposition and achievement post-test score ($p = .158$). Pre-test score was the only significant variable ($p < .01$).

Table 4-14 Canonical Correlation Analysis Testing Critical Thinking Disposition

	Canonical Root 1		Canonical Root 2	
Variables	*b*	*s*	*b*	*s*
Independent Variable Set				
Critical Thinking Score	.255	.346	-.355	-.249
Computer Proficiency Score	.387	.386	.926	.891
Achievement Pre-Test Score	.875	.872	-.269	-.322
Dependent Variable Set				
Attitude Score	.510	.656	.881	.755
Achievement Post-Test Score	.769	.865	-.668	-.501
PV		.590		.410
Rd		.057		.007
Rd_t				.064

$R^2_{c(1)} = .096$ ($p < .01$); $R^2_{c(2)} = .016$ ($p = .155$)

Note. *b* = standardized canonical coefficients (weights); *s* = structure coefficients; *PV* = proportion of variance in dependent variable set explained by dependent variate; *Rd* = redundancy; Rd_t = total redundancy

Table 4-15 Follow-Up Regression Analysis Showing the Relationship Between Critical Thinking Disposition Score and Achievement Post-Test Score

Variable	*B*	*SE*	*β*	*t*	*p*
Achievement Pre-Test Score	.215	.055	.252	3.95	< .01
Critical Thinking Disposition Score	.069	.049	.091	1.42	.158
Computer Proficiency Score	.027	.039	.045	.70	.487

Note. Achievement post-test score was the lone dependent variable in this analysis.

A liner combination of critical thinking disposition score, computer proficiency score, and achievement pre-test score accounted for 3.8% of the variance in attitude score. As seen in Table 4-16, critical thinking disposition score was not a significant

predictor of attitude score (p = .785). However, achievement pre-test score (p = .020) and computer proficiency score (p = .011) were significant predictors of student attitudes.

Table 4-16 Follow-Up Regression Analysis Showing the Relationship Between Critical Thinking Disposition Score and Attitude Score

Variable	*B*	*SE*	*β*	*t*	*p*
Achievement Pre-Test Score	.124	.053	.152	2.35	.020
Critical Thinking Disposition Score	.013	.047	.018	.27	.785
Computer Proficiency Score	.098	.038	.168	2.58	.011

Note. Attitude score was the lone dependent variable in this analysis.

Null Hypothesis Three

There is No Relationship Between Self-efficacy and a Linear Combination of Student Achievement and Attitudes in the Presence of Student Demographic Characteristics.

This hypothesis was tested using the canonical correlation procedure. Attitudes and achievement post-test scores were the dependent variables. Self-efficacy scores, computer proficiency, and achievement pre-test scores were the independent variables. Descriptive statistics and relationships between the variables can be seen in Table 4-17. As seen in Table 4-18, a significant relationship was found, Wilk's λ = .881, F (6,454) = 4.95 (p < .01). The null hypothesis that there is no relationship between self-efficacy and a linear combination of student achievement and attitudes in the presence of student demographic characteristics was rejected.

When examining the results of the canonical correlation, a linear combination of self-efficacy, computer proficiency score, and achievement pre-test score account for 6.9% of the variance in a linear combination of attitudes and achievement post-test score. Only the first canonical root was significant ($R^2_{c(1)}$ = .106, p < .01). When examining the correlation of the independent variables to this root, achievement pre-test score is the most correlated (r = .830). Following Warmbrod's (2003) assertion that any correlation

greater than .3 is meaningful, self-efficacy (r = .494) and computer proficiency score (r = .367) are also worth noting.

Table 4-17 Descriptive Statistics for Canonical Correlation Analysis Testing Self-Efficacy

Variable	Correlations					*M*	*SD*
	Y_1	Y_2	X_1	X_2	X_3		
Dependent Variable Set							
Achievement Post-Test Score (Y_1)	--	.180	.198	.040	.256	55.24	9.20
Attitude Score (Y_2)		--	.120	.201	.146	39.24	8.44
Independent Variable Set							
Self-Efficacy Score (X_1)			--	.089	.087	68.35	8.64
Computer Proficiency (X_2)				--	-.046	78.77	14.30
Achievement Pre-Test Score (X_3)					--	34.36	10.28

Table 4-18 Canonical Correlation Analysis Testing Self-Efficacy

Variables	Canonical Root 1		Canonical Root 2	
	b	*s*	*b*	*s*
Independent Variable Set				
Self-Efficacy Score	.390	.494	-.299	-.140
Computer Proficiency Score	.367	.370	.934	.928
Achievement Pre-Test Score	.809	.830	-.299	-.353
Dependent Variable Set				
Attitude Score	.516	.661	.878	.750
Achievement Post-Test Score	.764	.862	-.674	-.507
PV		.590		.410
Rd		.063		.006
Rd_t				.069

$R^2_{c(1)}$ = .106 (p < .01); $R^2_{c(2)}$ = .015 (p = .184)

Note. b = standardized canonical coefficients (weights); s = structure coefficients; PV = proportion of variance in dependent variable set explained by dependent variate; Rd = redundancy; Rd_t = total redundancy

Individual regressions were run as a follow-up to the canonical correlation procedure to better explain the contribution of self-efficacy score to attitudes and to achievement. The first regression used self-efficacy score, computer proficiency score, and achievement pre-test score as independent variables, with achievement post-test

score as the dependent variable. The combination of these independent variables explained 7.0% of the variance in achievement post-test score. As seen in Table 4-19, a significant relationship did not exist between self-efficacy score and achievement post-test score (p = .059). Achievement pre-test score was the only significant variable (p < .01).

Table 4-19 Follow-Up Regression Analysis Showing the Relationship Between Self-Efficacy Score and Achievement Post-Test Score

Variable	*B*	*SE*	*β*	*t*	*p*
Achievement Pre-Test Score	.209	.054	.245	3.85	<.01
Self-Efficacy Score	.128	.068	.122	1.90	.059
Computer Proficiency Score	.028	.039	.045	.71	.478

Note. Achievement post-test score was the lone dependent variable in this analysis.

A liner combination of self-efficacy score, computer proficiency score, and achievement pre-test score accounted for 4.2% of the variance in attitude score. As seen in Table 4-20, self-efficacy score was not a significant predictor of attitude score (p = .311). However, achievement pre-test score (p = .024) and computer proficiency score (p = .012) were significant .

Table 4-20 Follow-Up Regression Analysis Showing the Relationship Between Self-Efficacy Score and Attitude Score

Variable	*B*	*SE*	*β*	*t*	*p*
Achievement Pre-Test Score	.120	.053	.147	2.27	.024
Self-Efficacy Score	.067	.066	.067	1.02	.311
Computer Proficiency Score	.096	.038	.164	2.53	.012

Note. Attitude score was the lone dependent variable in this analysis.

Null Hypothesis Four

There is No Relationship Between Motivation and a Linear Combination of Student Achievement and Attitudes in the Presence of Student Demographic Characteristics.

This hypothesis was tested using a canonical correlation procedure. Attitudes and achievement post-test scores were considered dependent variables. Motivation scores,

computer proficiency scores, and achievement pre-test scores were treated as independent variables. Descriptive statistics and relationships between the variables can be seen in Table 4-21. As seen in Table 4-22, a significant relationship was found, Wilk's $\lambda = .849$, F (6,454) = 6.44 ($p < .01$). The null hypothesis that there is no relationship between motivation and a linear combination of student achievement and attitudes in the presence of student demographic characteristics was rejected.

Table 4-21 Descriptive Statistics for Canonical Correlation Analysis Testing Motivation

Variable	Correlations					*M*	*SD*
	Y_1	Y_2	X_1	X_2	X_3		
Dependent Variable Set							
Achievement Post-Test Score (Y_1)	--	.180	.252	.040	.256	55.24	9.20
Attitude Score (Y_2)		--	.144	.201	.146	39.24	8.44
Independent Variable Set							
Motivation Score (X_1)			--	.047	.157	29.42	3.67
Computer Proficiency (X_2)				--	-.046	78.77	14.30
Achievement Pre-Test Score (X_3)					--	34.36	10.28

When examining the results of the canonical correlation, a linear combination of critical thinking score, computer proficiency score, and achievement pre-test score accounted for 8.7% of the variance in a linear combination of attitudes and achievement post-test score. Only the first canonical root was significant ($R^2_{c(1)} = .135$, $p < .01$). When examining the correlation of the independent variables to this root, motivation and achievement pre-test score were both highly correlated ($r = .717$ and $r = .743$, respectively).

Regression analyses presented earlier in this chapter indicated that motivation score was significantly related to achievement post-test score ($p < .01$) and significantly related to attitude score ($p = .032$). The regression analysis for achievement post-test

score can be seen in Table 4-11 and the regression analysis for attitude score can be seen in Table 4-12.

Table 4-22 Canonical Correlation Analysis Testing Motivation

	Canonical Root 1		Canonical Root 2	
Variables	*b*	*s*	*b*	*s*
Independent Variable Set				
Achievement Motivation Score	.595	.717	-.375	-.321
Computer Proficiency Score	.285	.294	.948	.926
Pre-Test Score	.659	.743	-.013	-.110
Dependent Variable Set				
Attitude Score	.423	.580	.926	.814
Achievement Post-Test Score	.829	.910	-.591	-.415
PV		.582		.418
Rd		.079		.008
Rd_t				.087

$R^2_{c(1)} = .135$ ($p < .01$); $R^2_{c(2)} = .018$ ($p = .135$)

Note. *b* = standardized canonical coefficients (weights); *s* = structure coefficients; *PV* = proportion of variance in dependent variable set explained by dependent variate; *Rd* = redundancy; Rd_t = total redundancy

Summary

This chapter presented the findings of this study. The findings were organized around the objectives and hypotheses that guided this research. The objectives were: (1) describe the learning styles, critical thinking dispositions, self-efficacy, motivation, and demographic characteristics of participants in this study; (2) describe the variance in student achievement attributed to learning styles, critical thinking dispositions, self-efficacy, motivation, and student demographic characteristics; and (3) describe the variance in student attitudes attributed to learning styles, critical thinking dispositions, self-efficacy, motivation, and student demographic characteristics. The null hypotheses tested in this study were: (1) there is no difference in student achievement and attitudes, based on learning styles in the presence of student demographic characteristics; (2) there

is no relationship between critical thinking disposition and a linear combination of student achievement and attitudes in the presence of student demographic characteristics; (3) there is no relationship between self-efficacy and a linear combination of student achievement and attitudes in the presence of student demographic characteristics; and (4) there is no relationship between motivation and a linear combination of student achievement and attitudes in the presence of student demographic characteristics.

The findings presented in this chapter will be discussed in greater detail in Chapter 5. Additionally, conclusions, recommendation, and implications will also be presented

CHAPTER 5
SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine the influence of learning styles, self-efficacy, motivation, and critical thinking dispositions on student achievement and attitudes when an illustrated web lecture is used as the learning activity in an online-learning environment. Dependent variables for this study were student achievement and student attitudes. Independent variables were learning style, motivation, self-efficacy, and critical thinking dispositions. The following research objectives and hypotheses guided this study.

Objectives

This study was guided by three objectives.

1. Describe the learning styles, critical thinking dispositions, self-efficacy, motivation, and demographic characteristics of participants in this study.
2. Describe the variance in student achievement attributed to learning styles, critical thinking dispositions, self-efficacy, motivation, and student demographic characteristics.
3. Describe the variance in student attitudes attributed to learning styles, critical thinking dispositions, self-efficacy, motivation, and student demographic characteristics.

Null Hypotheses

All statistical analyses that involved significance testing were tested at an alpha of .05. This equates to a five percent chance of a Type I error, which occurs if significance was determined, when in fact there really was none.

1. Ho_1: There is no difference in student achievement and attitudes, based on learning styles in the presence of student demographic characteristics.

2. Ho_2: There is no relationship between critical thinking disposition and a linear combination of student achievement and attitudes in the presence of student demographic characteristics.

3. Ho_3: There is no relationship between self-efficacy and a linear combination of student achievement and attitudes in the presence of student demographic characteristics.

4. Ho_4: There is no relationship between motivation and a linear combination of student achievement and attitudes in the presence of student demographic characteristics.

Methods

This study was conducted using a causal-comparative design to examine the treatment of receiving instruction from an illustrated web lecture. The independent variables in this study were student learning styles, critical thinking disposition scores, motivation scores, and self-efficacy scores. The dependent variables were student achievement and student attitudes. Achievement pre-test scores, gender, computer proficiency, employment, experience, and grade point average were also included as covariates.

The population of this study was all students enrolled in online sections of FOS 2001 *Man's Food* at the University of Florida. A purposive sample was used that included all students enrolled in the online section from the 2003 summer semester (n = 322).

Effort was taken to merge the data collection of this study with regular instructional activities of the course. To accomplish this, all instrumentation was linked from the course web page and was designed to appear as if it where a normal part of the course.

At the beginning of the course, participants completed a four-part web-based instrument that assessed motivation, self-efficacy, and critical thinking dispositions. The instrument also collected demographic information from the respondents. Participants

were instructed to complete this instrument on the first day of class. A link from the course web site allowed participants to easily access the instrumentation.

In addition to the above instruments, students also completed achievement pre-tests and post-tests. The pre-test was developed as a web-based instrument that students completed prior to receiving the treatment. Participants were directed to take the pre-test by a link from the course web site. An email from the researcher was used to remind participants to complete this portion of the study. The treatment was a section of the course that used an illustrated web lecture as the learning activity. This section represented one-third of the content of this course and equated to nearly six hours of instruction. Participants were able to receive this treatment from streaming videos located on the course web site. As a backup, copies of the streaming videos were also available for checkout at the library. Following the treatment, the instructor used a web form to administer the post-test, which also served as the second examination in the course.

Learning styles and student attitudes about the illustrated web lecture were assessed during the last two weeks of the course after the treatment had been received. This was accomplished by using a web-based instrument linked from the course web site. A final email from the researcher advised participants to complete this last part of the study.

Learning styles were assessed using the Gregorc Style Delineator (Gregorc, 1982a). Validity for this instrument was evaluated by Gregorc (1982b) for both construct and predictive validity. Critical thinking dispositions were assessed using the Engagement, Maturity, and Innovativeness Critical Thinking Disposition Inventory (EMI) (Ricketts, 2003). Post hoc reliability analysis yielded a Cronbach's alpha of .88 for this instrument. The motivation instrument used in this study is attributable to Shih and Gamon (2001),

who developed the instrument based on original work by Pintrich et al. (1993). Post hoc reliability analysis yielded a Cronbach's alpha of .74 for this instrument. The self-efficacy instrument was developed by Riddle (1994). Post hoc reliability analysis yielded a Cronbach's alpha of .86 for this instrument. A researcher-developed instrument was utilized to collect demographic data in this study.

Prior content knowledge was assessed using an achievement pre-test. This instrument was created as a parallel form to the achievement post-test, which was developed by the instructor of the course. Post hoc reliability analysis was conducted using the Kuder-Richardson 20 formula, which yielded an alpha of .82. The achievement post-test was a parallel form to the pre-test, so a second reliability analysis was not performed. Data for the parallel achievement post-test consisted only of final scores provided by the instructor of the course.

Miller and Honeyman (1993) developed the attitudinal instrument consisting of 13 Likert-type items that assessed student attitudes toward videotaped instruction. Shih and Gamon (2001) made slight modifications to this instrument and used 11 items to assess student attitudes towards web-based instruction. The latter version was used in this study. Post hoc reliability analysis yielded a Cronbach's alpha of .85 for this instrument.

Data were analyzed using the SPSS ® Version 10.0 for Windows ® software package. Analysis for the first objective involved descriptive statistics and included frequencies, means, and standard deviations. The second two objectives were examined by using backwards regression analyses. The first hypothesis was tested using multivariate analysis of covariance (MANCOVA). The final three hypotheses were tested

using canonical correlations. Simple linear regression was used as a follow-up procedure in these hypotheses.

Summary of Findings

The findings of this study are summarized using the objectives and hypotheses presented in Chapter 1.

Objective One

The first objective sought to describe the sample used in this study. The sample consisted of students enrolled in the online section of FOS 2001 *Man's Food* from the 2003 summer semester at the University of Florida (n=322). Nearly half of the participants in this study were female (49.4%). The average age of participants was 21.13 years old (SD = 3.93). Participants represented nine academic colleges at the University of Florida. The greatest percentage of the participants was from the College of Liberal Arts and Sciences (n = 104, 32.3%). Self reported grade point averages ranged from 1.95 to 4.0. The mean GPA was 3.17 (SD = .516).

The number of distance or online classes that participants have previously taken ranged from 0 to 15. The mean of this distribution was 1.72 (SD = 2.35, n = 249). The median number of courses was 1.0. Almost 40% of the participants in this study (n = 98) had taken no previous online or distance education courses.

Participants in this study were also asked to indicate their self-perceived computer proficiency on a scale from 0 to 100. Responses ranged from 5 to 100. The mean was 78.77 (SD = 14.30).

Nearly half of the participants (n = 160, 49.7%) were employed. Of the employed participants, 130 indicated that they worked from 5 to 70 hours per week. The mean

hours worked per week was 27.97 (*SD* = 12.14). The median number of hours worked was 27.00.

The mean self-efficacy score was 68.35 (*SD* = 8.64). Scores ranged from 26 to 85. The possible range for self-efficacy scores was 17 to 85.

The mean motivation score was 29.42 (*SD* = 3.67), and ranged from 14 to 35. The possible range for motivation scores was 7 to 35.

The mean score for Critical Thinking Dispositions was 94.67 (*SD* = 11.39). Scores ranged from 44 to 121. The possible range for critical thinking disposition scores was 25 to 125. Index scores from the Engagement Construct ranged from 29.09 to 100.00. The mean was 78.25 (*SD* = 11.98). The Maturity Construct yielded index scores from 34.29 to 97.14. The mean of this construct was 68.34 (*SD* = 11.25). The Innovativeness Construct had scores that ranged from 31.43 to 100.00. The mean was 79.17 (*SD* = 11.46).

The majority of participants were concrete in their learning style. Eighty-two participants (33.5%) were classified as Concrete Sequential learners. Sixty-two participants (25.3%) were classified as Concrete Random learners, 52 participants (21.2%) were classified as Abstract Random learners, and 38 participants (15.5%) were classified as Abstract Sequential learners. Eleven participants (4.5%) were classified as having no dominant learning style.

Achievement was assessed using a pre-test and post-test. The maximum possible score for each assessment was 100. Achievement pre-Test scores ranged from 15 to 75. The mean was 34.36 (*SD* = 10.28). Scores on the achievement post-test ranged from 23 to

74. The mean score was 55.24 (*SD* = 9.20). Achievement gain scores ranged from –11 to 53. The mean gain score was 21.90 (*SD* = 11.69).

Participants expressed relatively favorable attitudes about the use of illustrated web lectures. Scores on the attitudinal instrument ranged from 15 to 55. The mean score was 39.24 (*SD* = 8.44). The possible range of scores was 11 to 55.

The relationships between the variables discussed above were also examined. Substantial correlations were discovered between self-efficacy and critical thinking disposition ($r = .689$), Concrete Sequential learning style and Concrete Random learning style ($r = -.641$), and Abstract Sequential learning style with Abstract Random learning style ($r = -.626$). Moderate correlations were discovered between self-efficacy and motivation ($r = .485$), motivation and critical thinking disposition ($r = .452$), Concrete Sequential learning style and Abstract Random learning style ($r = -.475$), and Abstract Sequential learning style with Concrete Random learning style ($r = -.334$).

Objective Two

This objective sought to describe the variance in student achievement attributed to learning styles, critical thinking dispositions, self-efficacy, motivation, and student demographic characteristics. Backwards regression analysis indicated that achievement pre-test scores ($t = 3.531$, $p < .01$) and motivation scores ($t = 3.610$, $p < .01$) contributed significantly ($\alpha = .05$) to predicting achievement post-test scores. These two variables accounted for 10.7% of the variance in achievement post-test scores.

Objective Three

This objective sought to describe the variance in student attitudes attributed to learning styles, critical thinking dispositions, self-efficacy, motivation, and student demographic characteristics. Backwards regression analysis revealed that computer

proficiency scores ($t = 3.153$, $p = .002$) and motivation scores ($t = 2.157$, $p = .032$) contributed significantly ($\alpha = .05$) to predicting attitude scores. These two variables accounted for 5% of the variance in attitude scores.

Null Hypothesis One

This null hypothesis was that there is no difference in student achievement and attitudes, based on learning styles in the presence of student demographic characteristics. The MANCOVA procedure was used to test this hypothesis. Hotelling's T^2 for the effects of learning style on the dependent variables was 4.82, F (8,430) = .890, $p = .583$. The effect size was .011 and the power was .272. Based on these findings, the null hypothesis was not rejected.

Null Hypothesis Two

The null hypothesis was that there is no relationship between critical thinking disposition and a linear combination of student achievement and attitudes in the presence of student demographic characteristics. Canonical correlation analysis was used to test this hypothesis. A significant relationship was found, Wilk's $\lambda = .890$, F (6,454) = 4.58 ($p < .01$). This null hypothesis was rejected. To gain a better understanding of the relationships between critical thinking dispositions and the two dependent variables, individual linear regressions were performed. A significant relationship did not exist between critical thinking disposition score and achievement post-test score ($p = .158$). Similarly, critical thinking disposition score was not a significant predictor of attitude score ($p = .785$).

Null Hypothesis Three

The null hypothesis of no relationship between self-efficacy and a linear combination of student achievement and attitudes in the presence of student demographic

characteristics was tested using a canonical correlation analysis. A significant relationship was found, Wilk's $\lambda = .881$, F (6,454) = 4.95 ($p < .01$), therefore this null hypothesis was rejected. To gain a better understanding of the relationships between self-efficacy and the two dependent variables, individual linear regressions were run. No significant relationship was found between self-efficacy score and achievement post-test score ($p = .059$). Additionally, self-efficacy score was not a significant predictor of attitude score ($p = .311$).

Null Hypothesis Four

The null hypothesis of no relationship between motivation and a linear combination of student achievement and attitudes in the presence of student demographic characteristics was tested using a canonical correlation analysis. A significant relationship found, Wilk's $\lambda = .849$, F (6,454) = 6.44 ($p < .01$). The hypothesis was rejected. To gain a better understanding of the relationships between motivation and the two dependent variables, individual linear regressions were performed. Motivation was significantly related to post-test score ($p < .01$) and significantly related to attitude score ($p = .032$).

Conclusions

The sample used in this study was not randomly drawn from the population. With this limitation in mind, and based on the findings of this study, the following conclusions were drawn.

1. Participants in this study were mainly concrete in their learning style, had high critical thinking dispositions, exhibited high levels of self-efficacy, and were highly motivated. They also expressed a degree of high self-perceived computer skills, but had little previous experience with distance or online education.

2. When an illustrated web lecture is used to deliver content, students with higher motivation and higher prior content knowledge tend to achieve at a higher level.

3. When an illustrated web lecture is used to deliver content, students with higher motivation and higher self-perceived computer proficiency tend to have more favorable attitudes.

4. When an illustrated web lecture is used to deliver content, students of varying learning styles achieve at similar levels and have similar attitudes toward the instructional strategy.

5. When an illustrated web lecture is used to deliver content, critical thinking dispositions tends to have no significant influence on achievement and attitudes toward the instructional strategy.

6. When an illustrated web lecture is used to deliver content, self-efficacy tends to have no significant influence on achievement and attitudes toward the instructional strategy.

7. When an illustrated web lecture is used to deliver content, students with higher levels of motivation tend to exhibit higher achievement and more favorable attitudes toward the instructional strategy.

Discussion and Implications

Objective One - Describe the learning styles, critical thinking dispositions, self-efficacy, motivation, and demographic characteristics of participants in this study.

Conclusion: Participants in this study were mainly concrete in their learning style, had high critical thinking dispositions, exhibited high levels of self-efficacy, and were highly motivated. They also expressed a degree of high self-perceived computer skills, but had little previous experience with distance or online education.

It was expected that the majority of participants in this study would be concrete in their learning style, because concrete learners grasp information from the world through the physical senses, while abstract learners grasp information through reason, emotion, and intuition (Gregorc, 1982a). Given the scientific nature of the content of this course (Food Science), it is reasonable to expect that it would attract students that prefer to use their senses to gather objective information. Other research has shown that undergraduate students at the University of Florida enrolled in large service courses offered by the College of Agricultural and Life Sciences were mainly concrete in their learning style. For example, Myers and Dyer (2003) reported that 57% of the students in their sample

were Concrete Sequential or Concrete Random. In a similar study, Grage and Dyer (2003) reported that 69% of their sample was either Concrete Sequential or Concrete Random.

It was, however, not expected that participants in this study would have high critical thinking dispositions. The sample used in this study consisted of undergraduate students at the University of Florida. Previous research with another group of University of Florida undergraduate students from the College of Agricultural and Life Sciences indicated that critical thinking dispositions were lower (Rudd et al., 2000). However, the researchers reported differences in critical thinking dispositions between students of differing majors within the College of Agricultural and Life Sciences. The highest critical thinking dispositions were observed from students majoring in Microbiology, while the lowest were from students in Agricultural Education and Communication. Perhaps the academic majors of participants in the current study could explain their high critical thinking dispositions. Unfortunately, respondents were only asked to indicate their academic college, not their actual major. Given the variability of majors within many colleges, differences were not observed.

The course used in this study was an introductory level food science course designed for students not majoring in food science. Historically, this course has had a high degree of student success. As such, it is reasonable to expect that the participants of this study entered into the course with a strong belief that they would be successful. Therefore, it is not surprising that participants in this study had a relatively high level of self-efficacy. Self-efficacy can be increased if the student observed a model that successfully completes the task or learns the material (Schunk, 2000). Therefore,

observing or having knowledge of other students that have previously been successful in this course, learning by an illustrated web lecture, can raise the observer's self-efficacy (Schunk, 2000).

Motivation is the process of instigating and sustaining goal-directed behavior (Schunk, 2000). This study was conducted during the summer semester. Historically, students enroll in summer classes to accelerate their education, take courses they have missed, or retake courses they have done poorly in (Patterson, Sedlacek, & Tracey, 1980; Rosenthal & Gottesman, 2001). Although not assessed as part of this study, it is reasonable to assume that the participants of this study enrolled in this course for similar reasons. Given these reasons for enrollment, it is also reasonable to assume that participants enrolled with a goal of successfully completing this course. Therefore, students were motivated to instigate the behaviors necessary to successfully meet their goal for completing this course.

The University of Florida has minimum computer standards that all students enrolled are expected to be somewhat computer proficient. Students in the sample used in this study had the choice of enrolling in a face-to-face section of FOS 2001 or an online section. Therefore, given the nature of the distance delivery method used in the online section of the course, students were expected to be computer proficient. Students with low computer proficiency likely enrolled in the face-to-face section. It was also expected that participants in this study had little or no previous experience with distance or online education. This course was offered as a near-distance education course. Although increasing in frequency, near-distance courses are limited at the University of Florida.

Therefore, students who attend on-campus classes have likely had little need and limited opportunities to enroll in other distance or online classes.

Objective Two - Describe the variance in student achievement attributed to learning styles, critical thinking dispositions, self-efficacy, motivation, and student demographic characteristics.

Conclusion: When an illustrated web lecture is used to deliver content, students with higher motivation and higher prior content knowledge tend to achieve at a higher level.

Theories of motivation postulate that higher motivation can produce greater achievement (Schunk, 2000). As such, higher achievement would be expected for students that set goals and instigate behaviors designed to meet those goals. The findings of this study are consistent with this theory and consistent with existing research. For example, in a study of web-based learning, Shih and Gamon (2001) found that motivation accounted for nearly one-fourth of the variance in achievement, as measured by course grade and Oxford et al. (1993) reported that motivation affected performance in a foreign language course delivered by distance education.

It is also reasonable to assume that students that enter into an educational setting with greater knowledge of the content will achieve at a higher level at the conclusion of instruction. The findings of this study support this premise, as indicated by the relationship between prior knowledge, as measured by achievement pre-test scores, and achievement, measured by achievement post-test scores.

Learning styles, self-efficacy, and critical thinking dispositions did not contribute significantly to explaining the variance in achievement. Previous research was inconclusive about the influence of learning styles on achievement. The findings of the current study are consistent with the studies that found no differences (Day, Raven, & Newman, 1998; Freeman, 1995; Shih & Gamon, 2001).

In this study, self-efficacy was correlated to achievement post-test scores; however, it was also correlated to motivation. The relationship between self-efficacy and motivation is supported in the literature (Bandura, 1986). Given the relationship between these two variables, the model building procedure selected the variable that explained the greatest amount of the variance, motivation. With motivation in the model, self-efficacy did not significantly explain any more of the variance. It is reasonable to assume that a student's belief about their potential for success influences their success (Bandura, 1986).

Previous studies that examined the effects of critical thinking dispositions on achievement in a distance-learning environment were not found to compare the results of the current study to. The instructor prepared achievement test employed in this study assessed mainly lower level recall information. Perhaps if participants were assessed at a higher level, including problem-solving, critical thinking dispositions would have statistically contributed to predicting achievement. This proposition is supported by the findings of Cano and Martinez (1991).

Objective Three - Describe the variance in student attitudes attributed to learning styles, critical thinking dispositions, self-efficacy, motivation, and student demographic characteristics.

Conclusion: When an illustrated web lecture is used to deliver content, students with higher motivation and higher self-perceived computer proficiency tend to have more favorable attitudes.

Results of this study indicated that motivation influences achievement, and that a relationship exists between achievement and attitudes toward an illustrated web lecture. From a practical perspective, if a student is academically successful when a specific instructional strategy is used, they likely have favorable attitudes about that instructional strategy. Therefore, in the context of this study, motivation influences achievement, which produces more favorable attitudes toward an illustrated web lecture. The

relationship between motivation and attitudes has been reported before. Mauldin (2001) reported that student attitudes of the perceived effectiveness of a distance course are influenced by motivation.

Given the nature of the technology used to deliver an illustrated web lecture, it was expected that students with greater computer proficiency would have more favorable attitudes toward an illustrated web lecture. Previous research has shown that computer proficiency influences achievement in a distance-learning environment. For example, Dutton et al. (2002) indicated that a student's prior experience with computers improved their performance as measured by course grades.

The rationale for the relationship between achievement and attitudes toward the instructional strategy has been established and is supported by the findings of this study. Another possible contributing factor to attitudes toward an illustrated web lecture was technical difficulties associated with the technology. The separation of the students from the instructor in a distance-learning environment necessitated that students take more responsibility for their learning, including handling of any technical difficulties that arose. Students with greater computer proficiency likely had fewer technical difficulties and were likely able to handle minor technical difficulties without assistance. As a result, student with higher computer proficiency had more favorable attitudes of an illustrated web lecture.

Learning style, self-efficacy, and critical thinking dispositions did not significantly contribute to predicting student attitudes. The research consulted in developing a theoretical framework for this study presented an unclear picture of the effects of learning style on attitudes in a distance-learning environment. The findings of the current study

are consistent with the researchers that reported that learning styles do not influence student attitudes (Day, Raven, & Newman, 1998; Miller, 1995a; Riddle, 1994).

Self-efficacy was not significantly correlated to attitudes; however, it was correlated to motivation. The relationship between self-efficacy and motivation has been discussed earlier in this chapter. As such, it is reasonable to expect that when building a model to predict attitudes that both variables would not remain in the model. The findings of the current study are inconsistent with the findings of Lim (2001) and Riddle (1994) who reported that self-efficacy was related to attitudes. However, neither of these studies examined motivation. Perhaps if these studies had included motivation, their findings would have been similar to the current study.

Previous research that examined the influence of critical thinking dispositions on student attitudes in a distance-learning environment was not found to compare the results of the current study to. Students in this study exhibited relatively high levels of critical thinking dispositions and relatively favorable attitudes toward an illustrated web lecture. Perhaps greater variability in critical thinking dispositions would show a relationship between the two variables. Given the limited interaction between the student with the instructor and other students associated with an illustrated web lecture, it is reasonable to assume that participants in this study learned the content in relative isolation. Given this isolation, it is plausible that students with lower abilities to critically think and reason about complex concepts would have struggled more with learning the content, without additional assistance from the instructor or other students. As such, these students may have had less favorable attitudes toward an illustrated web lecture.

Null Hypothesis One - There is no difference in student achievement and attitudes, based on learning styles in the presence of student demographic characteristics.

Conclusion: When an illustrated web lecture is used to deliver content, students of varying learning styles achieve at similar levels and have similar attitudes toward the instructional strategy.

Previous studies that examined the influence of learning styles on achievement and attitudes have reported mixed findings (Daniel, 1999; Day et al., 1998; Freeman, 1995; Oxford et al., 1993). Students with a dominant learning style of Abstract Random (AR) value relationships and interactions with others (Gregorc, 1982a). Likewise, students with a dominant learning style of Abstract Sequential (AS) thrive in an environment in which they can share their knowledge with others (Gregorc, 1982a). An illustrated web lecture is an instructional strategy that has no student-student interaction and only one-way student-instructor interaction. Given the lack of interaction in an illustrated web lecture, it was hypothesized that students with AR and AS learning styles would have lower achievement and less favorable attitudes. However, no differences were observed. As reported in Chapter 2, the effects of learning styles are inconclusive in a distance-learning environment. The findings of the current study are consistent with previous studies that showed no differences (Day, Raven, & Newman, 1998; Riddle, 1994; Shih & Gamon, 2001).

This phenomenon may be partially attributable to the condensed nature of summer courses. The course used in this study lasted only six weeks. Perhaps AR and AS students enrolled in this course with the attitude that "I can do anything for six weeks." Another possible explanation of this phenomenon is that the Gregorc Style Delineator indicates a student's "preferred" learning style (Gregorc, 1982a). Many students, especially students that have been academically successful, are adept at learning in many different ways.

Although these students had preferred learning styles of AR and AS, they may have been accustomed to learning in ways that are inconsistent with their preferred learning style. As a result, no differences between students of varying learning styles were observed.

Null Hypothesis Two - There is no relationship between critical thinking disposition and a linear combination of student achievement and attitudes in the presence of student demographic characteristics.

Conclusion: When an illustrated web lecture is used to deliver content, critical thinking dispositions tends to have no significant influence on achievement and attitudes toward the instructional strategy.

It was expected that critical thinking dispositions would have an influence on achievement and attitudes, however, the no relationship was found. Previous research that examined the influence of critical thinking dispositions on achievement and attitudes was not found, so a comparison of the current results was not possible.

Participants in this study had relatively high critical thinking dispositions. As discussed earlier in this chapter, perhaps if greater variance where present in the sample, a relationship would have been found. Another contributing factor to this phenomenon may have been the type of content assessed by the achievement pre-test and post-test. Nearly all the items on these instruments involved the recall of facts presented during the lesson. Perhaps if items on these instruments involved more analyzing and problem solving, the influence of critical thinking dispositions on achievement would have been much greater.

Null Hypothesis Three - There is no relationship between self-efficacy and a linear combination of student achievement and attitudes in the presence of student demographic characteristics.

Conclusion: When an illustrated web lecture is used to deliver content, self-efficacy tends to have no significant influence on achievement and attitudes toward the instructional strategy.

Theory indicates that student self-efficacy is related to effort and ultimately achievement (Schunk, 2000). Therefore, it was expected that students with higher self-efficacy would achieve at a higher level and subsequently have more favorable attitudes. This premise was consistent with the finding of previous research (Laughlin, 1998; Lim, 2001; Riddle, 1994). However, no relationship was found.

As reported and discussed earlier in this chapter, participants in this study had relatively high self-efficacy. This was attributed to the high degree of student success that typically characterizes this course. Very few students had low self-efficacy. Perhaps if greater variance in self-efficacy were observed, differences in attitudes and achievement would have been seen.

Null Hypothesis Four - There is no relationship between motivation and a linear combination of student achievement and attitudes in the presence of student demographic characteristics.

Conclusion: When an illustrated web lecture is used to deliver content, students with higher levels of motivation tend to exhibit higher achievement and more favorable attitudes toward the instructional strategy.

Results presented earlier in this chapter indicated that when examining achievement and attitudes separately, motivation was influential to both. Findings in this study also were reported that showed that there is a relationship between achievement and attitudes. Therefore, it was not surprising that when examining achievement and attitudes together that motivation was influential. This finding was consistent with Mauldin (2001), Oxford et al. (1993), and Shih and Gamon (2001).

Recommendations for Practitioners

Based on the findings of this study, the following recommendations for were made for practitioners:

1. Computer proficiency is predictive of positive attitudes toward an illustrated web lecture. Computer proficiency should be assessed at the beginning of an illustrated web lecture course and, if this high level does not exist, strategies should be implemented to increase the computer proficiency of students.

2. Because students of varying learning styles achieve at similar levels and have similar attitudes toward an illustrated web lecture, instructors should continue to use this instructional strategy to reach broad audiences of students.

3. Because an increase in motivation relates to an increase in student achievement and positive attitudes toward an illustrated web lecture, higher motivated students are better suited for instruction delivered by illustrated web lectures. If a broad audience of varied levels of motivation is found, the instructor should either implement strategies within the course to develop high motivation or consider other learning activities.

Recommendations for Further Research

Based upon the findings of this study, the following recommendations for further research were made:

1. The sample for this study was purposively selected. This study should be replicated using procedures that allow a higher degree of randomization and ultimately more generalizability.

2. This study was conducted during a condensed summer term. The sample was demographically consistent with sections of this course offered in regular semesters (M. Marshall, personal communication, April 10, 2003). However, it is unknown if differences exist between students in the summer term and students in regular terms in motivation, self-efficacy, and critical thinking dispositions. It is recommended that the study be replicated during a regular length semester to see if similar levels of these variables and relationships between the variables are observed.

3. Significant correlations were discovered between self-efficacy, motivation, and critical thinking dispositions. The relationship between self-efficacy and motivation is supported in the literature (Bandura, 1986). However, the relationships of critical thinking dispositions to motivation and to self-efficacy were not found in the research base. Further research should be conducted to better explore and explain this phenomenon.

4. In this study, an illustrated web lecture was used only to deliver course content in the food science area. It is recommended that this study be replicated using other content areas as the focus. Perhaps in other content areas, variables that were not influential in this study would be.

5. Only a small portion of the variance in achievement and attitudes could be explained by learning styles, self-efficacy, critical thinking dispositions, motivation, and student demographics. It is recommended that further research be conducted to identify additional variables that may explain more of the variance. Identifying additional variables may help determine if there are other student characteristics that make an illustrated web lecture better suited for specific types of students.

6. An illustrated web lecture is only one learning activity used to deliver content in a distance or online classes. This study should be replicated to see how learning styles, self-efficacy, critical thinking dispositions, motivation, and student demographics influence achievement and attitudes when other instructional strategies or learning activities are used. Although learning styles, self-efficacy, and critical thinking dispositions were not influential for achievement and attitudes for an illustrated web lecture, they may be for other learning activities. Building the research base in this area will ultimately allow for high quality instruction that meets the needs of individual students

Reflections

Upon completion of this study, the researcher reflected on the process. As such, if replicating this process, several things would be done differently. First, a single item was used to assess computer proficiency. Given the emergence of this variable, an established multiple-item instrument would be used. Secondly, a derivation of the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1993) was used in this study (Shih & Gamon, 2001). If done again, the researcher would use the original MSLQ. Thirdly, the researcher used student names to track responses through the data collection points. This proved to be problematic, as some students did not use the same name on each instrument (for example, ‘Tom’ and ‘Thomas’), as the software did not recognize the two as being the same. It would have been better to assign a participant number.

Given the minimal amount of variance explained by the models created with the data from this study, other variables should have been included. In retrospect, participants should have been asked to indicated if they had viewed all of the illustrated web lectures, and if so how many times. It may have also been beneficial to know the study strategies used by each participant to prepare for the achievement post-test. Perhaps these variables would have helped to explain a greater amount of the variance in achievement and attitudes.

APPENDIX A
DATA COLLECTION POINT 1 INSTRUMENTS

The first data collection point consisted of the self-efficacy instrument, critical thinking dispositions instrument, motivation instrument, and demographics instrument. These instruments were collectively administered as a web based form (see Figure A-1). The complete text of the instruments is presented below the figure.

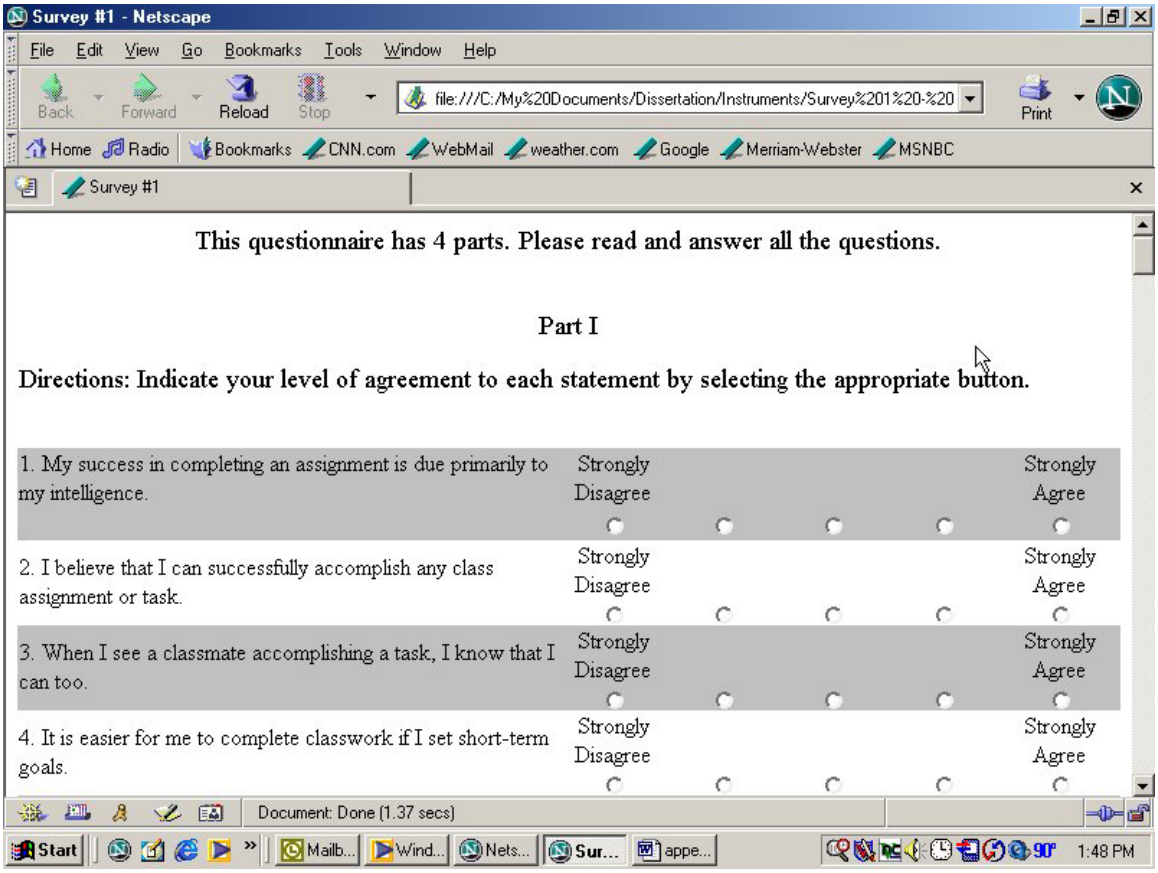

Figure A-1 Screen Capture of Data Collection Point 1

Part I – Self-Efficacy Instrument

Directions: Indicate your level of agreement to each statement by selecting the appropriate button.

	SD	D	U	A	SA
1. My success in completing an assignment is due primarily to my intelligence.	1	2	3	4	5
2. I believe that I can successfully accomplish any class assignment or task.	1	2	3	4	5
3. When I see a classmate accomplishing a task, I know that I can too.	1	2	3	4	5
4. It is easier for me to complete classwork if I set short-term goals.	1	2	3	4	5
5. My success in completing an assignment is due to the amount of effort I put into it.	1	2	3	4	5
6. I like to have my teacher tell me if I'm doing well on an assignment, so that I'll know that I'm doing it right.	1	2	3	4	5
7. If I feel anxious while working on any classwork, I know it's because I don't feel capable of doing it.	1	2	3	4	5
8. I will complete an assignment no matter how hard it is.	1	2	3	4	5
9. When I fail at a task, I try again.	1	2	3	4	5
10. When I fail at a task, I try a different strategy to accomplish it.	1	2	3	4	5
11. I can accomplish any task I want to if I have enough time.	1	2	3	4	5
12. When I fail at a task, I want to know what I did wrong.	1	2	3	4	5
13. I have control over the outcome of all of my educational experiences.	1	2	3	4	5
14. I expect to succeed.	1	2	3	4	5
15. I try harder at tasks I enjoy.	1	2	3	4	5
16. When I fail at a task, I try harder.	1	2	3	4	5
17. I know when to give up and quit trying.	1	2	3	4	5

Part II – Critical Thinking Dispositions Instrument

Directions: Indicate how much you agree or disagree with each numbered statement by selecting the appropriate button.

	SD	D	U	A	SA
1. When someone disagrees with me I usually tune him or her out.	1	2	3	4	5
2. I look for opportunities to solve problems.	1	2	3	4	5
3. I am interested in many issues.	1	2	3	4	5
4. It is important for me to have a deep understanding of more than one issue.	1	2	3	4	5
5. I am able to relate to a wide variety of issues.	1	2	3	4	5
6. I ask lots of questions in a learning environment.	1	2	3	4	5
7. I enjoy finding answers to challenging questions.	1	2	3	4	5
8. I am a good problem solver.	1	2	3	4	5
9. I am confident that I can reach a reasonable conclusion.	1	2	3	4	5
10. It is important to be well informed.	1	2	3	4	5
11. I am not likely to change my opinions even when I am given new information that might conflict with them.	1	2	3	4	5
12. I enjoy solving problems.	1	2	3	4	5
13. I know I have biases and if other people can't accept that it is their problem.	1	2	3	4	5
14. I am able to apply my knowledge to a wide variety of issues.	1	2	3	4	5
15. I enjoy learning even when I am not in school.	1	2	3	4	5
16. I can quickly judge people and decide whether or not I can get along with them.	1	2	3	4	5
17. I am able to explain things clearly.	1	2	3	4	5
18. I ask good questions when trying to clarify a solution.	1	2	3	4	5
19. I present issues in a clear and precise manner.	1	2	3	4	5
20. When deciding what or who to believe, I consider how my own biases affect my opinion.	1	2	3	4	5
21. I search for the truth even when it makes me uncomfortable.	1	2	3	4	5
22. I keep on working on things until I get them right.	1	2	3	4	5
23. I will go out of my way to find the right answers to a problem.	1	2	3	4	5
24. Most problems have many solutions that would work to solve the problem.	1	2	3	4	5
25. I make quick decisions and avoid asking questions that may complicate the process.	1	2	3	4	5
26. Most issues have one right answer	1	2	3	4	5

Part III – Motivation Instrument

Directions: Indicate how typical each statement is of you by selecting the appropriate button.

	Not at all typical of me				Very much typical of me
1. I want to get better grades than other students.	1	2	3	4	5
2. I expect to do well in this class.	1	2	3	4	5
3. Studying appropriately, I can learn the material.	1	2	3	4	5
4. I prefer course material that arouses my curiosity.	1	2	3	4	5
5. I am satisfied with trying to understand content.	1	2	3	4	5
6. Course material is useful to learn.	1	2	3	4	5
7. I think of the questions I cannot answer.	1	2	3	4	5
8. I am interested in the content area of this course.	1	2	3	4	5
9. I think of how poorly I am doing.	1	2	3	4	5

Part IV – Demographics Instrument

Please provide the following information about yourself.

1. Last Name: First Name:

NOTE: Names will only be used to keep track of the information you provide. This information will never be released publicly. After all information is collected, your name will be deleted.

2. Email Address:

3. Gender: Male Female

4. Grade Point Average:

5. Age:

6. College:

7. Do you have a job? Yes No If Yes, How many hours per week do you work?

8. How many other online or distance courses have you taken?

9. How would you rate your computer skills? (0 = low to 100 = high)

The purpose of this investigation is to determine if specific student characteristics affect their performance in a distance-learning environment.

This study will consist of 3 surveys that will take about 20 minutes each to complete. Additionally, your course instructor will release the scores from the second examination to the researcher.

No risk of physical, psychological, or economic harm to participants is foreseen. There is no monetary compensation to you for participation. Your identity will be kept confidential to the extent provided by the law. Your information will be assigned a code number. Your name will not be used in any report.

Your participation in this study is completely voluntary. There is no penalty for not participating. You do not have to answer any questions you do not want to answer. You have the right to withdraw from the study at any time without consequence.
For questions regarding your rights as a research participant, please contact the UFIRB at 352-392-0433.

UF IRB Approval #2003-U-399.
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APPENDIX B
ACHIEVEMENT PRE-TEST

The achievement pre-test was administered as a web-based form (see Figure B-1). The complete list of items is below the figure. An asterisk (*) indicates the correct response.

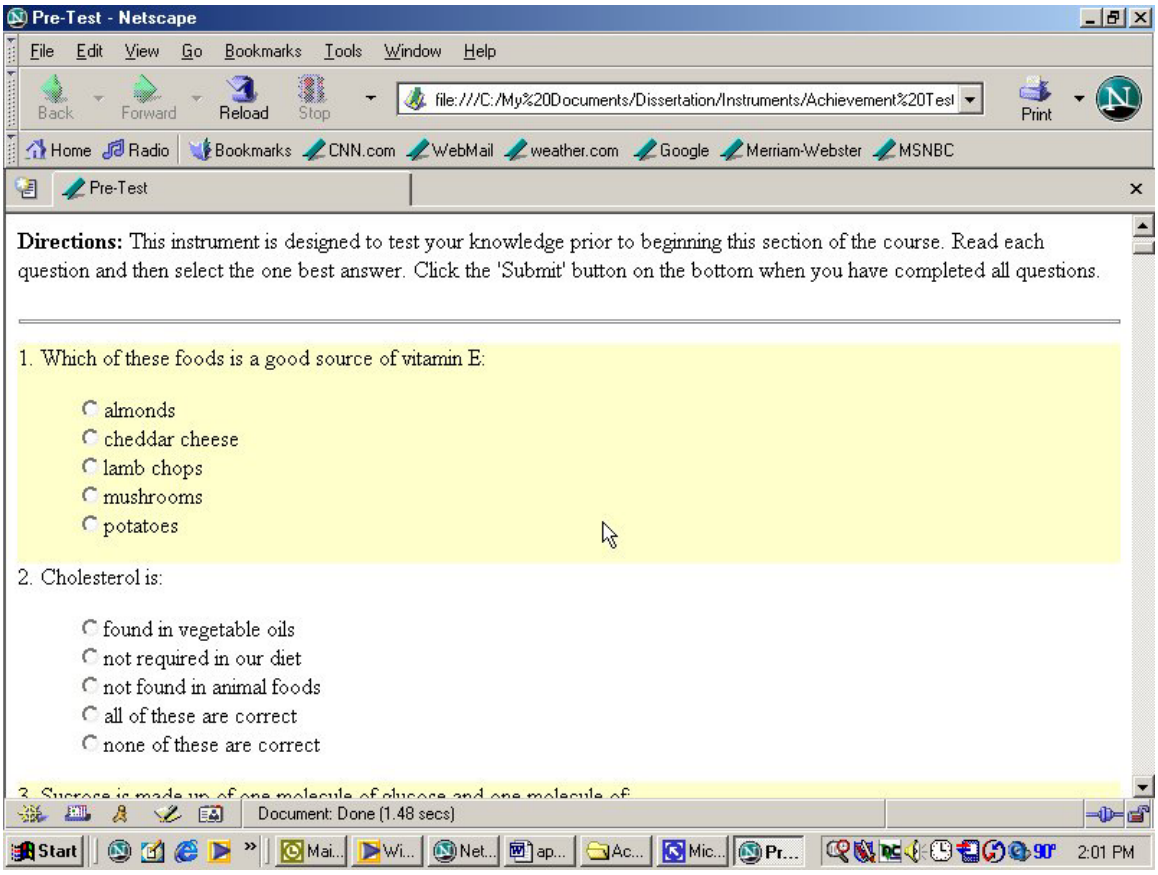

Figure B-1 Screen Capture of Achievement Pre-Test

1. Which of these foods is a good source of vitamin E:
* a. almonds
b. cheddar cheese
c. lamb chops
d. mushrooms
e. potatoes

2. Cholesterol is:
a. found in vegetable oils
* b. not required in our diet
c. not found in animal foods
d. all of these are correct
e. none of these are correct

3. Sucrose is made up of one molecule of glucose and one molecule of:
* a. fructose
b. galactose
c. maltose
d. all of these are correct
e. none of these are correct

4. Carbohydrate made up of two glucose molecules:
a. fructose
b. galactose
*c. maltose
d. all of these are correct
e. none of these are correct

5. Compared to non-smokers, a person who uses tobacco has a higher requirement for which nutrient:
a. magnesium
b. potassium
c. vitamin B12
*d. vitamin C
e. vitamin E

6. How much folic acid should women take before pregnancy and in early pregnancy to prevent certain birth defects:
a. 200 micrograms daily
b. 600 micrograms daily
*c. 400 micrograms daily
d. 800 micrograms daily
e. none of these are correct

7. Polysaccharide found in human liver and muscle:
a. cellulose
*b. glycogen
c. pectin
d. all of these are correct
e. none of these are correct

8. Lactose is:
a. called milk sugar
b. is found in mammals
c. made of glucose and galactose
*d. all of these are correct
e. none of these are correct

9. A study investigating relationship of diet to heart disease:
a. Burlington Study
*b. Framingham Study
c. New York Study
d. San Francisco Study
e. none of these are correct

10. Beriberi results from a diet lacking in:
a. niacin
b. riboflavin
*c. thiamin
d. vitamin B12
e. vitamin C

11. Cellulose and glycogen are polymers of glucose, what makes them different is:
a. cellulose is found in plants and glycogen is found in animals
b. cellulose is non-digestible while glycogen is digestible
c. the linkage between each glucose molecule is different for cellulose than glycogen
*d. all of these are correct
e. none of these are correct

12. The branch chain polysaccharide found in starch is:
*a. amylopectin
b. gliadin
c. glucose
d. gluten
e. none of these are correct

13. What percentage of people on earth are lactose intolerant:
a. 10%
b. 25%
c. 50%
d. 63%
*e. 80%

14. Major organ in body where alcohol is metabolized:
a. brain
b. heart
c. kidney
*d. liver
e. spleen

15. Honey has been implicated in the causation of:
a. atherosclerosis
b. beriberi
c. diabetes
*d. infant crib death (botulism poisoning)
e. none of these are correct

16. Viscosity of starches:
a. aids in thickening of the solution
b. helps in making a better gravy
c. occurs because the starch swells on heating
*d. all of these are correct
e. none of these are correct

17. Lactose intolerance is due to deficiency of the enzyme:
a. amylase
*b. lactase
c. maltase
d. sucrase
e. none of these are correct

18. The first type of fat substitutes for food products were:
*a. carbohydrate
b. fat
c. protein
d. all of these are correct
e. none of these are correct

19. Functions of carbohydrates include:
a. energy
b. flavor
c. protein sparing ability
*d. all of these are correct
e. none of these are correct

20. Dietary fiber will tend to:
a. decrease the frequency of bowel movements
b. decrease the total weight of bowel movements
c. increase transit time (cause fecal material to move slower)
d. all of these are correct
*e. none of these are correct

21. Sorbitol, mannitol and xylitol are considered:
a. simplese sweetners
b. sucralose sweetners
*c. sugar alcohols
d. all of these are correct
e. none of these are correct

22. Which sweetener used in the food industry is the sweetest:
a. acesulfame
b. aspartame
*c. saccharin
d. sorbitor
e. none of these are correct

23. What company has petitioned the FDA to use Olean/Olestra in foods:
a. Armour
b. Monsanto
*c. Proctor & Gamble (P&G)
d. all of these are correct
e. none of these are correct

24. Which formula below represents the form of alcohol in alcoholic beverages:
a. CH3OH
b. CH3COOH
c. C6H12O6
*d. CH3CH2OH
e. none of these are correct

25. The most widely distributed compound on earth is:
*a. carbohydrates
b. fats
c. proteins
d. vitamins
e. none of these are correct

26. Major enzyme system which breaks down alcohol:
*a. ADH (alcohol dehydrogenase)
b. MEOS (microsomal ethanol oxidizing system)
c. pyruvic dehydrogenase
d. all of these are correct
e. none of these are correct

27. Ethanol oxidation leads to:
a. impaired energy production from glucose
b. increased lipids and lipoproteins
c. steatosis
*d. all of these are correct
e. none of these are correct

28. Since most wines are 12% alcohol, they are:
a. 6 proof
b. 12 proof
c. 18 proof
*d. 24 proof
e. none of these are correct

29. Greatest incidence for diabetes occurs:
a. in the 1st decade of life
b. in the 2nd decade of life
c. in the 3rd decade of life
d. in the 4th decade of life
*e. none of these are correct

30. Malformations of face and head, and impaired learning are the result of:
a. beri beri
b. diabetes
*c. fetal alcohol syndrome
d. lactose intolerance
e. none of these are correct

31. One of the first fat substitutes that was a tapioca dextrin was called:
a. Avicel
*b. N-Oil
c. Tapitrin
d. all of these are correct
e. none of these are correct

32. Tooth decay requires:
a. a susceptible tooth
b. the presence of bacterial plaque
c. the presence of fermentable carbohydrate
*d. all of these are correct
e. none of these are correct

33. Triglycerides consist of:
a. amino acids
b. glycerol and amino acids
*c. glycerol and fatty acids
d. sugars
e. all of these are correct

34. A polyunsaturated fat:
a. is solid at room temperature
b. has no double bonds
*c. has two or more double bonds
d. all of these are correct
e. none of these are correct

35. The function of fats include:
a. energy
b. providing essential fatty acids
c. providing fat soluble vitamins
*d. all of these are correct
e. none of these are correct

36. An example of lipoprotein found in the body is:
a. Very low density (VLDL)
b. Low Density (LDL)
c. High Density (HDL)
d. Chylomicrons
*e. all of these are correct

37. What food product below is a major example of using hydrogenation to produce it:
a. butter
*b. margarine
c. mayonnaise
d. all of these are correct
e. none of these are correct

38. Cholesterol function is:
a. to maintain membrane integrity
b. to produce bile
c. to produce Vitamin D
*d. all of these are correct
e. none of these are correct

39. Foods that have approval by FDA to use sucralose include:
a. baked goods and baking mixes
b. beverages
c. jams and jellies
d. none of these are correct
*e. all of these are correct

40. Primary effects of insulin include:
*a. lowers blood sugar
b. raises blood sugar
c. stimulates sugar digestion
d. all of these are correct
e. none of these are correct

41. Which of the following high-fat foods is also a source of cholesterol:
*a. cheesecake
b. peanut butter
c. potato chips
d. all of these are correct
e. none of these are correct

42. An example of an essential fatty acid is:
*a. arachadonic acid
b. capric acid
c. stearic acid
d. all of these are correct
e. none of these are correct

43. A ketone body found in the breath in ketosis:
*a. acetone
b. hexose
c. mannitol
d. all of these are correct
e. none of these are correct

44. Sucralose structure is made up of:
a. sugar and agrose
b. sugar and levulose
*c. sugar that is selectively substituted with chlorine
d. all of these are correct
e. none of these are correct

45. Lipoproteins function is:
a. to remove protein from the cells
*b. to deliver fats to the cells and liver
c. to deliver protein to the cells
d. all of these are correct
e. none of these are correct

46. Sucralose is:
a. 100 times sweeter than sugar
*b. 600 times sweeter than sugar
c. 1200 times sweeter than sugar
d. all of these are correct
e. none of these are correct

47. Most dietary guidelines recommend limiting dietary cholesterol to:
a. 100 mg/day
b. 150 mg/day
c. 200 mg/day
d. 250 mg/day
*e. 300 mg/day

48. The U.S. Dietary Goals say the optimal ratio of dietary calories (CHO:FAT:PROTEIN) should be:
a. 33:33:33
b. 50:30:20
*c. 60:30:10
d. 70:20:10
e. 80:10:10

49. Gatorade contains:
a. glucose
b. potassium
c. sodium
d. water
*e. all of these are correct

50. The lipoprotein in blood thought to be protective against atherosclerosis:
*a. HDL (high density)
b. LDL (low density)
c. VLDL (very low density)
d. all of these are correct
e. none of these are correct

51. Disease for which at least 32 risk factors have been identified:
*a. atherosclerosis (coronary heart disease)
b. diabetes
c. diuresis
d. galactosemia
e. lactose intolerance

52. Mottled teeth is caused by:
a. calcium
*b. fluoride
c. iodide
d. iron
e. none of these are correct

53. Beta-carotenes are:
a. found in yellow and red fruits and veggies
b. precursors of vitamin A
c. responsible for carotenemia
*d. all of these are correct
e. none of these are correct

54. A vitamin deficiency that results when vitamin is lacking in the diet is called:
a. conditioned deficiency
b. secondary deficiency
*c. primary deficiency
d. all of these are correct
e. none of these are correct

55. Good source of vitamin A are:
a. eggs
b. fish oils
c. fortified milk
d. liver
*e. all of these are correct

56. The conversion of a chemical to vitamin activity in the body is termed a:
a. natural vitamin
b. vitamin antagonist
*c. vitamin precursor
d. all of these are correct
e. none of these are correct

57. Rickets results from a deficiency of:
a. vitamin A
b. vitamin C
*c. vitamin D
d. vitamin E
e. vitamin K

58. The antioxidant vitamin protecting cell and membrane damage is:
a. vitamin A
b. vitamin C
c. vitamin D
*d. vitamin E
e. vitamin K

59. Which formula best describes a simple carbohydrate:
a. CH3OH
*b. C6H12O6
c. CH3CH2OH
d. all of these are correct
e. none of these are correct

60. What food if consumed in large quantities can potentially lead to Goiter:
*a. cabbage
b. chicken
c. shrimp
d. all of these are correct
e. none of these are correct

61. The toxicity of beta-carotene is:
a. 1 x the RDA
b. 3 x the RDA
c. 5 x the RDA
d. all of these are correct
*e. none of these are correct

62. Rhodopsin:
a. contains vitamin A
b. is a pigment found in the eye
c. is necessary for night vision
*d. all of these are correct
e. none of these are correct

63. Which of the following is/are NOT a property of fat:
a. adds flavor and texture to foods
*b. extends life of red blood cells
c. is found in abundance in nuts & seeds
d. is required for cell membranes
e. is used as a source of energy

64. What explorer described vitamin A toxicity:
a. Sir Edmund Hillary
*b. Sir Douglas Mawson
c. Sir Thomas Johnson
d. all of these are correct
e. none of these are correct

65. A toxicity of the synthetic vitamin K in infants is:
a. beri beri
*b. kernicterus
c. ketosis
d. all of these are correct
e. none of these are correct

66. The sunshine vitamin is:
a. vitamin C
*b. vitamin D
c. vitamin E
d. vitamin K
e. none of these are correct

67. Iron utilization is affected by:
a. the form or iron (Fe++ or Fe+++)
b. phytic acid
c. vitamin C
*d. all of these are correct
e. none of these are correct

68. Pyridoxine is used in the metabolism of:
a. carbohydrate
b. DNA synthesis
c. fat
d. methyl transfer
*e. protein

69. The 3 D's of Pellegra included:
*a. dementia
b. diabetes
c. diuresis
d. all of these are correct
e. none of these are correct

70. Which of the following can be caused by vitamin A deficiency:
*a. blindness
b. kidney failure
c. osteomalacia
d. all of these are correct
e. none of these are correct

71. Good sources of iodide include:
a. hamburger
b. orange juice
*c. shellfish
d. all of these are correct
e. none of these are correct

72. A microcytic type of anemia is caused by:
a. calcium
b. cesium
*c. iron
d. all of these are correct
e. none of these are correct

73. The replacement of nutrients lost during processing is termed:
a. enrichment
b. nitrification
*c. restoration
d. all of these are correct
e. none of these are correct

74. Calcium toxicity can result in a higher risk of:
a. gall stones
b. kidney stones
c. plaque formation
*d. all of these are correct
e. none of these are correct

75. Collagen formation is aided by what nutrient:
a. vitamin A
b. vitamin B12
*c. vitamin C
d. vitamin E
e. none of these are correct

76. Which of the following foods can be recommended as a good source of thiamin:
a. chicken breast
b. lamb chops
*c. pork chops
d. prime rib
e. salmon

77. Vitamin C is required in the food of:
a. fruit-eating bat
b. guinea pigs
c. man
*d. all of these are correct
e. none of these are correct

78. Bleeding gums and delayed wound healing are signs of deficiency of:
a. vitamin B6
b. vitamin B12
*c. vitamin C
d. vitamin D
e. vitamin K

79. A calcium deficiency can cause:
a. osteoporosis
b. rigor mortis
c. tetany
*d. all of these are correct
e. none of these are correct

80. How much calcium is required by adults ages 18-50:
a. 500 milligrams daily
*b. 1000 milligrams daily
c. 1500 milligrams daily
d. 2000 milligrams daily
e. none of these are correct

81. Symptoms of ariboflavinosis, a deficiency of riboflavin include:
a. cheilosis
b. magenta tongue
c. seborrhea
*d. all of these are correct
e. none of these are correct

82. Coenzymes in a total enzymatic process are:
a. minerals
b. proteins
*c. vitamins
d. all of these are correct
e. none of these are correct

83. What is the newest nutrient added to the enrichment of grains:
a. biotin
*b. folic acid
c. niacin
d. all of these are correct
e. none of these are correct

84. Aids in the development of red blood cells:
a. biotin
b. niacin
*c. vitamin B12
d. all of these are correct
e. none of these are correct

85. Rate of cirrhosis (fibrous degeneration) of the liver in alcoholics is:
a. 1 in 1
b. 1 in 3
c. 1 in 5
*d. 1 in 7
e. 1 in 9

86. A fat which has no double bonds is a:
a. monounsaturate fat
b. polyunsaturate fat
*c. saturate fat
d. all of these are correct
e. none of these are correct

87. Which vitamin is known to cause nerve damage when taken in chronic high doses:
*a. vitamin B6
b. vitamin B12
c. vitamin C
d. vitamin D
e. vitamin K

88. What is the difference between glucose and galactose:
a. one is a pyranose sugar and the other a furanose sugar
*b. both are pyranose sugars with different positions of hydroxyl groups
c. both are furanose sugars
d. both are 5 carbon sugars
e. none of these are correct

89. A very yellow urine is due to the urinary excretion of excess:
a. niacin
*b. riboflavin
c. thiamin
d. vitamin A
e. vitamin C

90. Which population group is at high risk of vitamin B12 deficiency:
a. children
*b. elderly
c. people with arthritis
d. people with diabetes
e. pregnant women

91. Megaloblastic anemia is the result of:
a. biotin deficiency
*b. folic acid deficiency
c. pantothenate deficiency
d. thiamin deficiency
e. none of these are correct

92. Oxalic acid in spinach can inhibit the absorption of:
*a. calcium
b. fluorine
c. iodine
d. potassium
e. sodium

93. Potassium is:
a. an electrolyte
b. involved in maintaining osmotic pressure
c. the major intracellular cation
*d. all of these are correct
e. none of these are correct

94. Percent of population not at risk for hypertension:
a. 17
b. 32
c. 47
d. 65
*e. 83

95. Sodium deficiency can be caused by excessive:
a. sweating
b. urinating
c. vomiting
*d. all of these are correct
e. none of these are correct

96. Minerals are:
a. cofactors for enzymes
b. electrolytes
c. inorganic
*d. all of these are correct
e. none of these are correct

97. Which of the following would describe a salt:
a. Ca
b. Fe
*c. KCl
d. Na
e. none of these are correct

98. Excessive calcium intake can contribute to:
a. gallstones
b. kidney stones
c. tarter on teeth
*d. all of these are correct
e. none of these are correct

99. The vitamin which activates enzymes involved in CO2 metabolism:
*a. biotin
b. pantothenic acid
c. thiamin
d. all of these are correct
e. none of these are correct

100. Mineral can:
a. be essential for biological activity of molecules such as thyroxine
b. provide structural integrity for the body
c. regulate nerve impulses
*d. all of these are correct
e. none of these are correct

APPENDIX C
ACHIEVEMENT POST-TEST

The achievement post-test was administered by the instructor of the course used as the sample for this study. The instrument was administered through the use of WebCT in a computer lab. The instructor and/or teaching assistants were present during the administration of this instrument. The questions included in the achievement post-test are presented below. An asterisk (*) indicates the correct response.

1. The most widely distributed compound on earth is:
*a. carbohydrates
b. proteins
c. fats
d. vitamins
e. none of these are correct

2. Sucrose is made up of one molecule of glucose and one molecule of:
*a. fructose
b. galactose
c. maltose
d. all of these are correct
e. none of these are correct

3. Carbohydrate made up of two glucose molecules:
a. fructose
b. galactose
*c. maltose
d. all of these are correct
e. none of these are correct

4. Which formula best describes a simple carbohydrate:
a. CH3OH
b. CH3CH2OH
c. all of these are correct
d. none of these are correct
*e. C6H12O6

5. Polysaccharide found in human liver and muscle:
a. pectin
b. cellulose
*c. glycogen
d. all of these are correct
e. none of these are correct

6. Lactose is:
a. called milk sugar
b. made of glucose and galactose
c. is found in mammals
*d. all of these are correct
e. none of these are correct

7. What is the difference between glucose and galactose:
a. one is a pyranose sugar and the other a furanose sugar
*b. both are pyranose sugars with different positions of hydroxyl groups
c. both are furanose sugars
d. both are 5 carbon sugars
e. none of these are correct

8. Cellulose and glycogen are polymers of glucose, what makes them different is:
a. the linkage between each glucose molecule is different for cellulose than glycogen
b. cellulose is found in plants and glycogen is found in animals
c. cellulose is non-digestible while glycogen is digestible
*d. all of these are correct
e. none of these are correct

9. The branch chain polysaccharide found in starch is:
*a. amylopectin
b. gluten
c. gliadin
d. glucose
e. none of these are correct

10. What percentage of people on earth are lactose intolerant:
a. 10%
b. 25%
c. 50%
d. 63%
*e. 80%

11. Honey has been implicated in the causation of:
a. diabetes
*b. infant crib death (botulism poisoning)
c. atherosclerosis
d. beriberi
e. none of these are correct

12. Viscosity of starches:
a. aids in thickening of the solution
b. helps in making a better gravy
c. occurs because the starch swells on heating
*d. all of these are correct
e. none of these are correct

13. Lactose intolerance is due to deficiency of the enzyme:
a. sucrase
b. maltase
*c. lactase
d. amylase
e. none of these are correct

14. Functions of carbohydrates include:
a. energy
b. flavor
c. protein sparing ability
*d. all of these are correct
e. none of these are correct

15. Dietary fiber will tend to:
a. increase transit time (cause fecal material to move slower)
b. decrease the frequency of bowel movements
c. decrease the total weight of bowel movements
d. all of these are correct
*e. none of these are correct

16. Sorbitol, mannitol and xylitol are considered:
a. simplese sweetners
b. sucralose sweetners
*c. sugar alcohols
d. all of these are correct
e. none of these are correct

17. Which sweetener used in the food industry is the sweetest:
*a. saccharin
b. acesulfame
c. aspartame
d. sorbitor
e. none of these are correct

18. Major organ in body where alcohol is metabolized:
a. heart
b. brain
*c. liver
d. kidney
e. spleen

19. Which formula below represents the form of alcohol in alcoholic beverages:
a. CH3OH
*b. CH3CH2OH
c. C6H12O6
d. CH3COOH
e. none of these are correct

20. Major enzyme system which breaks down alcohol:
a. MEOS (microsomal ethanol oxidizing system)
*b. ADH (alcohol dehydrogenase)
c. pyruvic dehydrogenase
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e. none of these are correct

21. Ethanol oxidation leads to:
a. impaired energy production from glucose
b. increased lipids and lipoproteins
c. steatosis
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e. none of these are correct

22. Since most wines are 12% alcohol, they are:
a. 6 proof
b. 12 proof
c. 18 proof
*d. 24 proof
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a. in the 1st decade of life
b. in the 2nd decade of life
c. in the 3rd decade of life
d. in the 4th decade of life
*e. none of these are correct

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*a. the fetal alcohol syndrome
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c. the presence of fermentable carbohydrate
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b. amino acids
c. glycerol and amino acids
*d. glycerol and fatty acids
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a. Very low density (VLDL)
b. High Density (HDL)
c. Low Density (LDL)
d. Chylomicrons
*e. all of these are correct

30. What food product below is a major example of using hydrogenation to produce it:
*a. margarine
b. butter
c. mayonnaise
d. all of these are correct
e. none of these are correct

31. Cholesterol function is:
a. to produce bile
b. to maintain membrane integrity
c. to produce Vitamin D
*d. all of these are correct
e. none of these are correct

32. Cholesterol is:
a. found in vegetable oils
b. not found in animal foods
*c. not required in our diet
d. all of these are correct
e. none of these are correct

33. Which of the following high-fat foods is also a source of cholesterol:
a. none of these are correct
b. peanut butter
c. potato chips
d. all of these are correct
*e. cheesecake

34. An example of an essential fatty acid is:
a. capric acid
b. stearic acid
*c. arachadonic acid
d. all of these are correct
e. none of these are correct

35. A ketone body found in the breath in ketosis:
a. mannitol
b. hexose
*c. acetone
d. all of these are correct
e. none of these are correct

36. A study investigating relationship of diet to heart disease:
a. Defuniak Springs Study
*b. Framingham Study
c. Palatka Study
d. Orlando Study
e. none of these are correct

37. Lipoproteins function is:
*a. to deliver fats to the cells and liver
b. to deliver protein to the cells
c. to remove protein from the cells
d. all of these are correct
e. none of these are correct

38. Most dietary guidelines recommend limiting dietary cholesterol to:
a. 100 mg/day
b. 150 mg/day
c. 200 mg/day
d. 250 mg/day
*e. 300 mg/day

39. The U.S. Dietary Goals say the optimal ratio of dietary calories (CHO:FAT:PROTEIN) should be:
a. 33:33:33
b. 50:30:20
*c. 60:30:10
d. 70:20:10
e. 80:10:10

40. The utilization of fats for energy because carbohydrates are insufficient causes:
a. diverticulosis
b. galactosemia
c. ketosis
d. all of these are correct
e. none of these are correct

41. The lipoprotein in blood thought to be protective against atherosclerosis:
a. VLDL (very low density)
b. LDL (low density)
*c. HDL (high density)
d. all of these are correct
e. none of these are correct

42. Disease for which at least 32 risk factors have been identified:
a. diuresis
b. diabetes
*c. atherosclerosis (coronary heart disease)
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*a. primary deficiency
b. secondary deficiency
c. conditioned deficiency
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a. vitamin antagonist
*b. vitamin precursor
c. natural vitamin
d. all of these are correct
e. none of these are correct

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a. vitamin A
*b. vitamin D
c. vitamin E
d. vitamin C
e. vitamin K

48. The antioxidant vitamin protecting cell and membrane damage is:
a. vitamin A
b. vitamin D
*c. vitamin E
d. vitamin K
e. none of these are correct

49. Primary effects of insulin include:
a. stimulates sugar digestion
b. all of these are correct
c. raises blood sugar
d. none of these are correct
*e. lowers blood sugar

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a. 1 x the RDA
b. 3 x the RDA
c. 5 x the RDA
d. all of these are correct
*e. none of these are correct

51. Rhodopsin:
a. is a pigment found in the eye
b. is necessary for night vision
c. contains vitamin A
*d. all of these are correct
e. none of these are correct

52. Which of the following is/are NOT a property of fat:
a. is found in abundance in nuts & seeds
*b. extends life of red blood cells
c. adds flavor and texture to foods
d. is required for cell membranes
e. is used as a source of energy

53. What explorer described vitamin A toxicity:
*a. Sir Douglas Mawson
b. Sir Edmund Hillary
c. Christopher Columbus
d. all of these are correct
e. none of these are correct

54. A toxicity of the synthetic vitamin K in infants is:
*a. kernicterus
b. ketosis
c. beri beri
d. all of these are correct
e. none of these are correct

55. The sunshine vitamin is:
a. vitamin C
*b. vitamin D
c. vitamin E
d. vitamin K
e. none of these are correct

56. Pyridoxine is used in the metabolism of:
a. fat
b. carbohydrate
*c. protein
d. methyl transfer
e. DNA synthesis

57. The 3 D's of Pellegra included:
a. all of these are correct
b. none of these are correct
c. diuresis
d. diabetes
*e. dementia

58. Which of the following can be caused by vitamin A deficiency:
a. all of these are correct
*b. blindness
c. none of these are correct
d. kidney failure
e. osteomalacia

59. Which of these foods is a good source of vitamin E:
a. cheddar cheese
b. potatoes
c. mushrooms
*d. almonds
e. lamb chops

60. Compared to non-smokers, a person who uses tobacco has a higher requirement for which nutrient:
a. potassium
b. vitamin B12
c. vitamin E
d. magnesium
*e. vitamin C

61. The replacement of nutrients lost during processing is termed:
a. enrichment
*b. restoration
c. nitrification
d. all of these are correct
e. none of these are correct

62. Collagen formation is aided by what nutrient:
a. vitamin A
b. vitamin B12
*c. vitamin C
d. vitamin E
e. none of these are correct

63. Which of the following foods can be recommended as a good source of thiamin:
*a. pork chops
b. lamb chops
c. salmon
d. prime rib
e. chicken breast

64. Vitamin C is required in the food of:
a. fruit-eating bat
b. man
c. none of these are correct
d. guinea pigs
*e. all of these are correct

65. Bleeding gums and delayed wound healing are signs of deficiency of:
a. vitamin K
b. vitamin B12
c. vitamin B6
*d. vitamin C
e. vitamin D

66. Symptoms of ariboflavinosis, a deficiency of riboflavin include:
*a. all of these are correct
b. magenta tongue
c. none of these are correct
d. seborrhea
e. cheilosis

67. Coenzymes in a total enzymatic process are:
*a. vitamins
b. minerals
c. proteins
d. all of these are correct
e. none of these are correct

68. What is the <u>newest</u> nutrient added to the enrichment of grains:
a. niacin
b. biotin
*c. folic acid
d. all of these are correct
e. none of these are correct

69. Beriberi results from a diet lacking in:
a. niacin
b. riboflavin
*c. thiamin
d. vitamin B12
e. vitamin C

70. Rate of cirrhosis (fibrous degeneration) of the liver in alcoholics is:
a. 1 in 1
b. 1 in 3
c. 1 in 5
*d. 1 in 7
e. 1 in 9

71. A fat which has no double bonds is a:
a. polyunsaturate fat
*b. saturate fat
c. monounsaturate fat
d. all of these are correct
e. none of these are correct

72. Which vitamin is known to cause nerve damage when taken in chronic high doses:
*a. vitamin B6
b. vitamin K
c. vitamin D
d. vitamin C
e. vitamin B12

73. How much folic acid should women take before pregnancy and in early pregnancy to prevent certain birth defects:
a. 800 micrograms daily
*b. 400 micrograms daily
c. none of these are correct
d. 200 micrograms daily
e. 600 micrograms daily

74. Which population group is at high risk of vitamin B12 deficiency:
a. people with arthritis
b. pregnant women
c. children
d. people with diabetes
*e. elderly

75. Megaloblastic anemia is the result of:
*a. folic acid deficiency
b. pantothenate deficiency
c. biotin deficiency
d. thiamin deficiency
e. none of these are correct

76. Oxalic acid in spinach can inhibit the absorption of:
a. sodium
b. potassium
*c. calcium
d. iodine
e. fluorine

77. Potassium is:
a. the major intracellular cation
b. an electrolyte
c. involved in maintaining osmotic pressure
*d. all of these are correct
e. none of these are correct

78. Percent of population <u>not</u> at risk for hypertension:
a. 17
b. 32
c. 65
d. 47
*e. 83

79. Sodium deficiency can be caused by excessive:
a. sweating
b. vomiting
c. urinating
*d. all of these are correct
e. none of these are correct

80. Minerals are:
a. cofactors for enzymes
b. inorganic
c. electrolytes
*d. all of these are correct
e. none of these are correct

81. Which of the following would describe a salt:
a. Na
b. Ca
*c. KCl
d. Fe
e. none of these are correct

82. Excessive calcium intake can contribute to:
a. kidney stones
b. gallstones
c. tarter on teeth
*d. all of these are correct
e. none of these are correct

83. The vitamin which activates enzymes involved in CO2 metabolism:
a. thiamin
b. pantothenic acid
*c. biotin
d. all of these are correct
e. none of these are correct

84. Mineral can:
a. provide structural integrity for the body
b. regulate nerve impulses
c. be essential for biological activity of molecules such as thyroxine
*d. all of these are correct
e. none of these are correct

85. Gatorade contains:
a. water
b. glucose
c. sodium
d. potassium
*e. all of these are correct

86. A very yellow urine is due to the urinary excretion of excess:
*a. riboflavin
b. niacin
c. vitamin C
d. vitamin A
e. thiamin

87. Aids in the development of red blood cells:
a. biotin
*b. vitamin B12
c. niacin
d. all of these are correct
e. none of these are correct

88. How much calcium is required by adults ages 18-50:
*a. 1000 milligrams daily
b. 500 milligrams daily
c. 2000 milligrams daily
d. 1500 milligrams daily
e. none of these are correct

89. A calcium deficiency can cause:
a. tetany
b. rigor mortis
c. osteoporosis
*d. all of these are correct
e. none of these are correct

90. Calcium toxicity can result in a higher risk of:
a. gall stones
b. kidney stones
c. plaque formation
*d. all of these are correct
e. none of these are correct

91. A microcytic type of anemia is caused by:
a. calcium
*b. iron
c. cesium
d. all of these are correct
e. none of these are correct

92. Good sources of iodide include:
*a. shellfish
b. hamburger
c. orange juice
d. all of these are correct
e. none of these are correct

93. Iron utilization is affected by:
a. vitamin C
b. phytic acid
c. the form or iron (Fe++ or Fe+++)
*d. all of these are correct
e. none of these are correct

94. What food if consumed in large quantities can potentially lead to Goiter:
a. chicken
b. shrimp
*c. cabbage
d. all of these are correct
e. none of these are correct

95. Mottled teeth is caused by:
a. calcium
*b. fluoride
c. iron
d. iodide
e. none of these are correct

96. Sucralose is:
a. 100 times sweeter than sugar
*b. 600 times sweeter than sugar
c. 1200 times sweeter than sugar
d. none of these are correct
e. all of these are correct

97. Sucralose structure is made up of:
*a. sugar that is selectively substituted with chlorine
b. sugar and agrose
c. sugar and levulose
d. none of these are correct
e. all of these are correct

98. Foods that have approval by FDA to use sucralose include:
a. beverages
b. jams and jellies
c. baked goods and baking mixes
d. none of these are correct
*e. all of these are correct

99. One of the first fat substitutes that was a tapioca dextrin was called:
a. Tapitrin
*b. N-Oil
c. Avicel
d. all of these are correct
e. none of these are correct

100. What company has petitioned the FDA to use Olean/Olestra in foods:
a. Armour
b. Monsanto
*c. Proctor & Gamble (P&G)
d. all of these are correct
a. none of these are correct

APPENDIX D
DATA COLLECTION POINT 4 INSTRUMENTS

The fourth data collection point consisted of the learning styles instrument (the Gregorc Style Delineator) and the attitudes instrument. The instruments were collectively administered as a web-based form (see Figures D-1 & D-2). The complete list of items on the instruments can be seen below the figures.

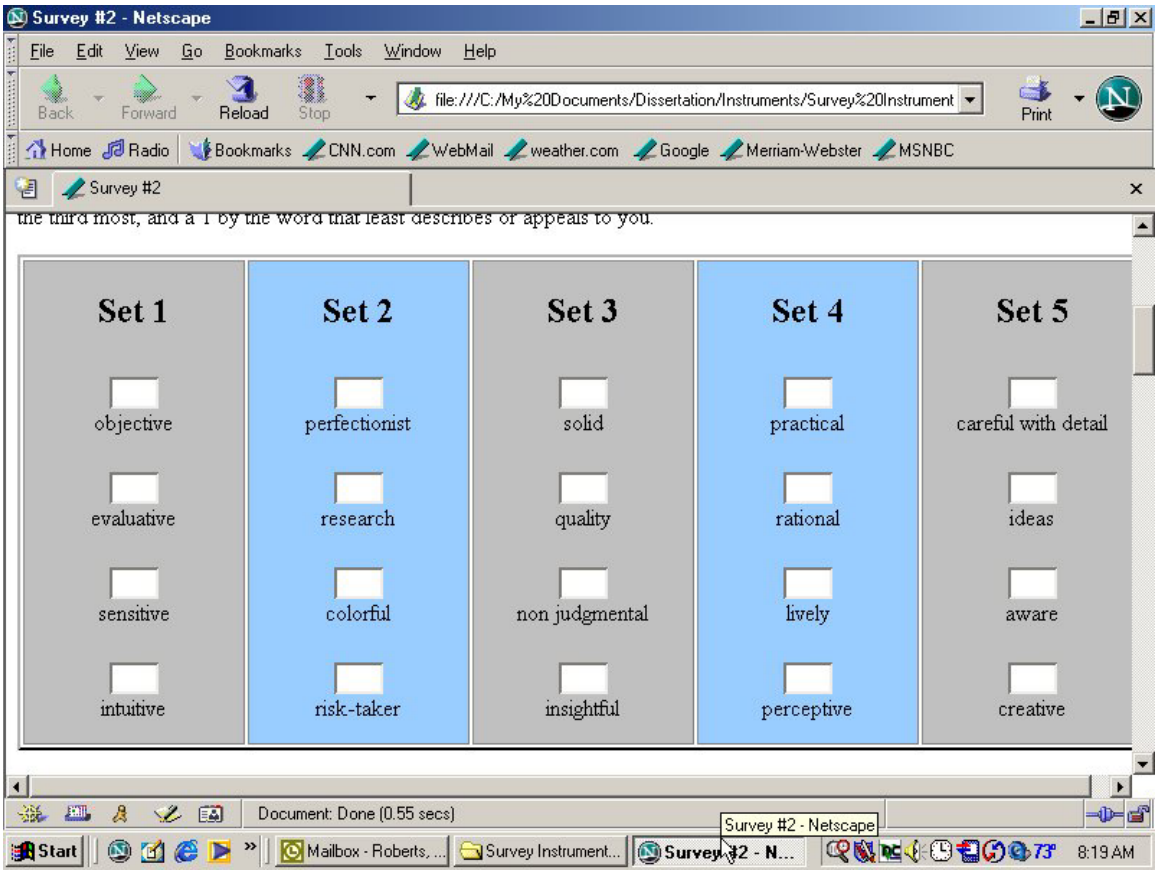

Figure D-1 Screen Capture of Learning Styles Instrument

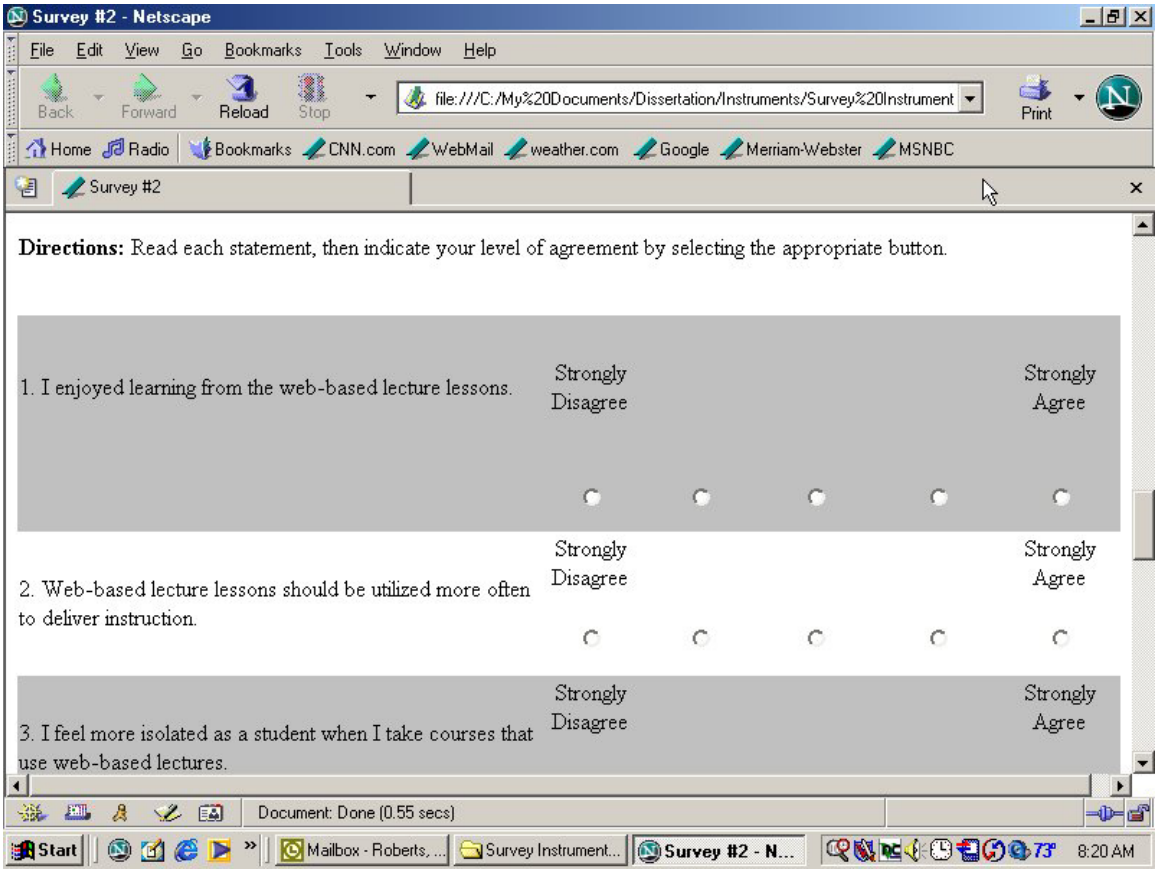

Figure D-2 Screen Capture of Attitudes Instrument

Part I – Learning Style Assessment

Directions:
Below are 10 sets of words arranged in columns. Each set contains 4 words.
For each set, examine the words. Place a 4 by the word that best describes or appeals to you, a 3 by the second most, a 2 by the third most, and a 1 by the word that least describes or appeals to you.

Set 1	Set 2	Set 3	Set 4	Set 5
☐ Objective	☐ Perfectionist	☐ Solid	☐ Practical	☐ Careful with Detail
☐ Evaluative	☐ Research	☐ Quality	☐ Rational	☐ Ideas
☐ Sensitive	☐ Colorful	☐ Non Judgmental	☐ Lively	☐ Creative
☐ Intuitive	☐ Risk-taker	☐ Insightful	☐ Perceptive	☐ Creative

Set 6	Set 7	Set 8	Set 9	Set 10
☐ Thorough	☐ Realistic	☐ Ordered	☐ Persistent	☐ Product Oriented
☐ Logical	☐ Referential	☐ Proof	☐ Analytical	☐ Judge
☐ Spontaneous	☐ Empathy	☐ Attuned	☐ Aesthetic	☐ Person Oriented
☐ Trouble Shooter	☐ Innovative	☐ Multi-solutions	☐ Experimenting	☐ Practical Dreamer

Part II – Attitudes Instrument

This survey is designed to assess your attitude about the use of web-based lectures to deliver instruction.

A **web-based lecture** is an instructional strategy that uses PowerPoint presentations with sound to deliver course content over the web.

Directions: Read each statement, then indicate your level of agreement by selecting the appropriate button.

	SD	D	U	A	SA
1. I enjoyed learning from the web-based lecture lessons.	1	2	3	4	5
2. Web-based lecture lessons should be utilized more often to deliver instruction.	1	2	3	4	5
3. I feel more isolated as a student when I take courses that use web-based lectures.	1	2	3	4	5
4. I would recommend web-based lecture courses to my friends.	1	2	3	4	5
5. Learning through web-based lecture is convenient.	1	2	3	4	5
6. Web-based lectures allow me to control the pace of my learning.	1	2	3	4	5
7. I prefer web-based lectures to traditional classroom instruction.	1	2	3	4	5
8. Learning through web-based lectures is boring	1	2	3	4	5
9. I would enroll in another web-based lecture course.	1	2	3	4	5
10. Web-based lecture courses provide me with learning opportunities that I otherwise would not have.	1	2	3	4	5
11. I would not take web-based lecture courses if I had other means of acquiring course credit.	1	2	3	4	5

APPENDIX E
CORRESPONDENCE

Email Reminder 1

Thank you for participating in this research study. Your input is valuable and greatly appreciated.

By my records, you have submitted the following portions of the study:

Survey 1: Yes

Content Pre-Test: «PRETEST»

- If you have not completed the Content Pre-Test, please do so by Wednesday, July 16 at midnight.
- The final portion of the study (Survey 2) can be completed **after 7/16** and must be completed before 8/1.

You may use this link (http://deeval.ifas.ufl.edu/roberts/) to access the surveys.

If you have any questions, please contact me using the information below.

Once again, thank you,

Grady

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

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Email: TGRoberts@mail.ifas.ufl.edu
http://plaza.ufl.edu/groberts
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Email Reminder 2

«V2»,

Thank you for participating in this research study. Your input is valuable and greatly appreciated.

By my records, you have submitted the following portions of the study:

Survey 1: Yes

Content Pre-Test: «ROUND2»

Survey 2: «ROUND3»

If you have not completed Survey 2, please do so. The deadline is 8/1/03.

You may use this link (http://deeval.ifas.ufl.edu/roberts/) to access the surveys.

If you have any questions, please contact me using the information below.

Once again, thank you,

Grady

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

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~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Email Reminder 3

Attention FOS 2001 students,

The final deadline for completing the last part of the study is Friday, August 1st at midnight.

If you haven't completed the last part, please do so ASAP.

http://deeval.ifas.ufl.edu/roberts/

Once again, thank you for participating in this study.

Grady

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APPENDIX F
IRB APPROVAL

UNIVERSITY OF FLORIDA

Institutional Review Board

98A Psychology Bldg.
PO Box 112250
Gainesville, FL 32611-2250
Phone: (352) 392-0433
Fax: (352) 392-9234
E-mail: irb2@ufl.edu
http://rgp.ufl.edu/irb/irb02

DATE: 23-Apr-2003

TO: Mr T. Grady Roberts
PO Box 110540
Campus

FROM: C. Michael Levy, Chair CML/TF
University of Florida
Institutional Review Board

SUBJECT: **Approval of Protocol #2003-U-399**

TITLE: Determining the effects of student characteristics on achievement and attitudes in a distance-learning environment

SPONSOR Unfunded

I am pleased to advise you that the University of Florida Institutional Review Board has recommended approval of this protocol. Based on its review, the UFIRB determined that this research presents no more than minimal risk to participants, and based on 45 CFR 46.117(c), authorizes you to administer the informed consent process as specified in the protocol.

If you wish to make any changes to this protocol, including the need to increase the number of participants authorized, you must disclose your plans before you implement them so that the Board can assess their impact on your protocol. In addition, you must report to the Board any unexpected complications that affect your participants.

If you have not completed this protocol by 16-Apr-2004, please telephone our office (392-0433), and we will discuss the renewal process with you.

It is important that you keep your Department Chair informed about the status of this research protocol.

CML:dl/tf

cc: Vice President for Research

Equal Opportunity/Affirmative Action Institution

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BIOGRAPHICAL SKETCH

Thomas Grady Roberts II was born March 25, 1969, at a military hospital outside of London, England. His father was in the military until 1985. As such, Mr. Roberts moved frequently, including living in Spain and Germany. When his father retired from the military, his family remained in Tampa, Florida, where he graduated from Gaither High School in 1987.

Mr. Roberts received his Bachelor of Science degree in agriculture from the University of Florida in 1991, with a major in agricultural education. As part of his degree requirement, he interned at Eisenhower Middle School in Gibsonton, Florida.

Upon graduating in 1991, Mr. Roberts accepted an agricultural education teaching position at Tomlin Junior High School in Plant City, Florida. He taught there until 1995, when he accepted a position at Durant High School, also in Plant City, Florida. In 1999, he transferred to Turkey Creek Middle School in Plant City, Florida, where he taught until 2001.

Mr. Roberts was a member of the Hillsborough County Vocational Agriculture Teachers Association, the Florida Association of Agricultural Educators, the National Association of Agricultural Educators, and numerous other organizations. His efforts as an agricultural education teacher and FFA advisor have been recognized by numerous organizations, including an Honorary State FFA Degree from the Florida FFA Association.

While teaching, Mr. Roberts received his Master of Agriculture degree, with a specialization in agricultural education, from the University of Florida in 2000. He completed most of the coursework for this degree through distance education.

In 2001, Mr. Roberts was awarded a College of Agricultural and Life Sciences Alumni Fellowship and began work on a Ph.D. full time at the University of Florida. While there, he served as a graduate teaching and research assistant. He taught or co-taught four undergraduate courses in the agricultural education program and supervised three student teachers. Additionally, he conducted research related to agricultural education and distance education.

Mr. Roberts was married to Michelle Alexander in 1993. They have a daughter, Elizabeth, born in 1996.