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Clinical Laboratory Science University Faculty Learning Types and the Use of Information Technology in the Classroom.

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A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in The School of Vocational Education

by

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ABSTRACT

This study was designed to explore the status of learning types of clinical laboratory science university faculty and their use of information technology in the classroom. Traditionally clinical laboratory science education has been lecture and lab sessions. However, with the advent of the information age, professors are moving from the role of lecturer to facilitator. Some professors are in tune with the new information tools while others are not interested at all.

This research had a two-fold purpose: 1) to explore who was using technology in the classroom and identify what they were using, and 2) to search for a possible relationship between a professor's learning type and the use of information technology in the classroom. To meet these ends, the researcher chose to conduct a national survey of university-based clinical laboratory science professors. A national list of faculty was compiled and a random sample was chosen. This study employed a commercial learning type tool (McCarthy's Learning Type Measure) and a self-designed information technology use instrument.

Data received from the survey were analyzed using the statistical package SPSS. Descriptive statistics were performed using the demographic variables, learning types,
and information technology use scores. Two one-way analysis of variance were performed, one with the technology scores and the highest preferred learning type quadrant and one with the technology scores and the lowest preferred learning type quadrant. A significant difference was found between the technology scores and the highest preferred learning type quadrant. A Tukey’s analysis indicated a significant difference between the use of information technology for quadrant three learners and quadrant two learners. A multiple linear regression was run with the technology score as the dependent variable and the learning type quadrant and demographics as the independent variables. Seventeen percent of variance in the technology scores was explained by the independent variables which were loaded into the regression equation.

This research indicated that there was a relationship between the respondent professors’ learning type and their use of information technology in the classroom. Although this cannot be generalized to the population, the researcher would recommend this topic for further study.
CHAPTER 1

INTRODUCTION

In education, there are a number of ways to approach teaching. Many educators teach in the manner they were taught (Marshall, 1991). According to Ingram (1994), ". . . most beginning teachers teach as they have been taught . . . and that's basically the same way they did it some 20 years ago, with a textbook, chalkboard, and an overabundance of teacher talk" (p. 115). In clinical laboratory science (CLS), this is usually a lecture and student lab format. Often a chalkboard and overhead projector is all that is needed to conduct a productive lecture on any number of subjects. However, is that sufficient in today's society of students who have grown up with Nintendo®, home computers, and other electronic wonders? Many educators today were not taught with technology beyond a 35-mm slide projector so how do they catch up with today's technological advances? Who is using information technology today in CLS education? Is information technology relevant in our profession? Are there learning styles that 'lend' some educators to search out new uses of information technology in the classroom or to reject the concept altogether? The goal of this research is to delve into these questions.
According to Webster's New World Dictionary (Guralnik, 1980), information may be defined as, "... knowledge acquired in any manner; facts; data; learning; lore ..." (p. 723). In the Web Dictionary of Cybernetics and Systems, Hornung (1997) defines technology as, "... an object or sequence of operations created by man to assist in achieving some goal" (p. 1). These definitions combined could describe information technology as the acquisition of knowledge through objects created by man to assist in achieving the goal of accessing information. Hornung's (1997) definition is more concise when he says that information technology is, "Technology dealing with information processing, storage, and transmission. This includes in particular computer technology and different communication technologies ..." (p. 1).

The 'objects' alluded to in Hornung's definition of technology seem to refer to electronic devices. For the purposes of this research, the devices implied in the use of information technology will include: audio cassette players, video cassette players, video cassette recorders (VCRs), laserdisc players, compact disc players, 35-mm slide projectors, video cameras, satellite downlinks, computer projection systems, and Internet connections. These are all tools we utilize to impart information in both business and classroom settings.
In the NASSP Newsleader (Educational technology survey, 1996), Bill Gates is quoted as saying, "The most important use of information technology is to improve education" (p. 9). Also Ingram stated, "... one of the fastest and most effective ways to improve education is to use computers and the technologies they control to expand the capacity and effectiveness of teachers (1994, p. 116). Why, then, do some professor's embrace information technology and others shun it? The literature points often to the lack of training (Faison, 1996; Hope, 1996; Hurst, 1994; Ingram, 1994; Levin & Thurston, 1996; O'Neil, 1995), and, to a lesser degree, anxiety over using computers (Ayersman, & Reed, 1995-1996; George, & Camarata, 1996; George, Hons, Sleeth, & Pearce (1996); Gilbert, 1995; and Smith & Kotrlik, 1990). However, this study is attempting to get a different perspective by looking at a professor's learning style or type. Why was learning style singled out? Because a person's learning style incorporates so many facets of an individual. Learning style or type may refer to any number of differences in cognition, conceptualization, affective domain, and/or behavior. According to McCarthy (Samples, Hammond, & McCarthy, 1985), a person's learning type is determined by their personality, brain hemispheric preference, and the way they perceive and process information. The knowledge of one's learning type
can help in teaching individuals and helping them to 'stretch' in areas that they may be uncomfortable (Samples et al., 1985). According to McCarthy (Samples et al., 1985), the values of knowing personal learning styles or types include: 1) being able to recognize stylistic behaviors in self and others, 2) accepting and appreciating the reasons why people act the way they do, 3) being able to systemically review and revise traditional instructional plans, and 4) honoring individual diversity in learning preferences and accommodating those needs via instructional opportunities. This is why learning styles could be helpful in teaching faculty how to utilize information technology. According to Hurst (1994), the most successful approach they found for teacher training in the use of information technology was through peer tutoring using self-designed modules. However, he even recognized the need for meeting the needs of the individuals when he stated, "Packaged programs used in conjunction with a personal development plan, a sort of 'technology IEP,' can address different learning styles and allow teachers to learn at their own pace" (p. 75).

Need for the Study

In CLS, the literature on information technology in the classroom has focused mostly on the use computer tutorials (Astion, et al., 1996; Cookson, et al., 1994;
Nguygen, & Uthman, 1994; Wiggers, & Hicock, 1996) and the Internet (Amra, 1997; Klatt, 1996). The only literature found in CLS on learning styles was focused on student teachers in allied health (Vittetoe & Hooker, 1983). This article described a three-year study of the learning styles of allied health university students who were preparing to become health occupation teachers. The inventory employed to identify learning styles was developed by Rezler and French (1975) which categorized students in three areas: abstract/concrete, teacher-centered/student-centered, and individual/interpersonal. The researchers found that medical technologists (synonymous with clinical laboratory scientists) and physical therapists, "...indicated that they preferred concrete and teacher-centered learning styles" (p. 48).

However, the studies mentioned above did not answer the following questions. What type of information technologies are CLS faculty using in the classroom? Who uses information technology? Could the faculty's learning style or choice of discipline affect the use of technology in the classroom? These are questions to be addressed in this study.

Upon researching the topics of learning styles and information technology, a void was found in the field of CLS education research. This study will add to the body of
knowledge in the profession by providing foundational information concerning CLS university professors' learning styles and their use of information technology in the classroom.

**Purpose of the Study**

The purpose of the study was to identify CLS university professors' demographics, learning types, level of expertise with information technology tools, and use of information technology in the classroom. Additionally, the possible difference between learning styles and the use of information technology in the classroom will be explored.

**Objectives**

Objectives were developed to address the purpose of the study. The objectives were as follows:

1. Describe CLS university professors by selected demographics (age, gender, highest level of education, and major discipline).

2. Determine the learning type of CLS university professors through use of the Learning Type Measure inventory.

3. Quantify the use of information technology by CLS university professors through a self-reporting utilization instrument.
4. Ascertain the level of expertise in the use of information technology by CLS university professors through a self-reporting utilization instrument.

5. Determine if there is a difference in the use of information technology in the classroom by the professors’ learning type.

6. Determine if variance in the use of technology in the classroom can be explained by CLS university professors’ learning type and selected demographic variables (age, gender, level of education, and major discipline).

**Definition of Terms**

**Brain dominance**: The theory that most people function in one dominant hemisphere of the brain, either right, left, or whole brain, with each having different attributes: left - verbal and analytical functions; right - subserving, non-verbal, visuospatial and gestalt or holistic aspects; and whole brain - equally using both sides of the brain (Eubank & Sparks, 1993; McCarthy, 1990).

**CD database**: Resource databases maintained on CD-ROM. Examples include the following: ERIC, CINAHL and MedLine.

**CD-ROM**: "A compact disc with read-only memory (ROM). CD-ROMs provide a lot of storage capacity, which is required by programs with memory intensive features like
digitized sound, graphics, and video" (Kanning, 1994, p. 45).

Chat: A form of synchronous interaction between two or more individuals through text-based communication. This is accomplished through the Internet using some type of host such as the Internet service provider or shareware (e.g., ICQ or Powwow).

Client-server system: A client is a personal computer used by an individual to access information on a server such as an in-house network (Intranet) or the Internet. A server is the network computer that stores files that are designed to be accessed by remote users (clients) such as files to be shared within business or as home pages on the Internet (Hahn, 1996).

Clinical laboratory science (CLS): The medical profession dealing with analysis of blood and body fluids in four major disciplines/specialities: Hematology (emphasis on cellular components), Clinical Chemistry (emphasis on chemical analytes), Immunohematology (emphasis on immunologic reactions between patient and donor) and Microbiology (emphasis on infectious diseases).

Compressed video: When video is sent over fiberoptic cables to remote sites. Participants at each site are able to view other participants and communicate via desktop.
speakers. This is often used in distance learning classrooms.

**Computer assisted instruction (CAI):** A self-contained instructional tutorial designed for use on the computer that may incorporate text, graphics, sound, animation, etc, to assist students in learning specific information.

**Computer assisted interactive video instruction (CAIVI):** A method of instruction utilizing video incorporated into a computer assisted tutorial.

**Computer video conferencing:** When digital video cameras are utilized to link people at two, or more, distant sites through computer interfaces.

**Educational technology:** Sometimes used interchangeably with information technology.

**Electronic mail (e-mail):** A form of electronic messaging that allows users to send and receive text, graphics, sounds, etc., through the use of phone lines or direct connection (i.e., network servers).

**Homepage:** The major page of an Internet file. The homepage often has links to other Internet resources and/or other files the homepage owner has put on the Internet. An example of a homepage might be the title page of a new course to be offered on the Internet. Links on the homepage might lead to files such as a course syllabi, recommended readings, or supplemental resources.
Information technology: "Technology dealing with information processing, storage, and transmission. This includes in particular computer technology and different communication technologies. . ." (Hornung, 1997, p. 1).

Internet: "A worldwide computer network connecting individuals, organizations, and other computer networks to information services and electronic mail" (Kanning, 1994, p. 45).

Laserdisc (or Videodisc): "A disc on which video information is stored; it is read with a laser beam in a manner analogous to a phonograph needle picking up sound from a record" (Kanning, 1994, p. 45).

Learning preference: The fairly regular choice of one type of learning situation or environment over another.

Learning style: A generic term referring to the way people engage in learning. May be used interchangeably with learning type.

Learning Style Inventory (LSI): An instrument designed by David Kolb to measure an individual's learning style based on the way they perceive and process information (Kolb, 1984).

Learning type: May be used interchangeably with learning style.
Learning Type Measurement (LTM): A tool designed by Bernice McCarthy to, "... help teachers, managers and communicators: identify situations in which different people function most effectively; map out strategies for improving individual potential; motivate learners with strategies crafted to their unique learning styles; and understand the key differences in the way people select, organize, represent and process information and experience" (Excel, Inc., 1997).

Medical technology: This is an older term that may be used interchangeably with clinical laboratory science (CLS). Multimedia: "The term multimedia means that more than one medium of communication is employed to deliver a message. Multimedia presentations may combine video, sound, graphics, still photography, animation, and text" (Kanning, 1994, p. 40)

Satellite conferencing: The use of satellite connections to view distance learning conferences. Often the participants are also linked via phone lines to interact with people at other distant sites involved in the same conference.

Scanner: "A device that optically senses text, graphics, photos, or other images and creates a picture of them in digital form on a computer" (Kanning, 1994, p. 45).

World Wide Web (WWW): "A client/server system used to access all types of information (hypertext, graphics,
sounds, gopher information, Usenet news groups, WAIS
databases, and so on), and to allow users to send their own
information to a program to be processed” (Hahn, 1996, p. 600).

Limitations of the Study

The sample in this study was drawn from university-based clinical laboratory educators in the continental United States, Alaska and Hawaii. This may limit the scope of generalizability since CLS hospital-based and international educators were not included. Both the learning styles tool and information technology instrument were self-reporting instruments.

Summary

Information technology is important in society and should be modeled in the classroom. Some educators tend to embrace technology while others shun it. This research is designed to identify CLS university professors’ learning styles and their use of information technology in the classroom. Once this information is established, an attempt can be made to search out why educators approach the use of information technology in the classroom differently through statistical analysis of the data. Identification of how one perceives and processes information (learning style or type) is basic to the integration of the teaching/learning process. Both aspects
of this study serve as the foundation on which other research can be built regarding improved practices in the field. The approach of examining learning styles in relation to information technology is a unique way of looking at why some use it and others don't. This study provides information for individuals to use in preparing CLS educators for improved teaching in their respective disciplines.
CHAPTER 2
REVIEW OF LITERATURE

Introduction

This review examined components of learning styles and information technology in the classroom. The amount of material available on these topics was overwhelming, yet very little was found in the field of clinical laboratory science (CLS) exploring the questions posed in this research.

In learning styles, most articles were directed into two areas: identifying students' learning styles (Cavanagh, Hogan, & Ramgopal, 1995; Katz & Heimann, 1991; and Merritt, 1983) or the exploration of learning styles as a predictor of academic success (Bath, & Blais, 1993; Haislett, Hughes, Atkinson, & Williams, 1993; and Joyce-Nagata, 1996). Some researchers were more directed toward a review of current literature rather than classroom research (Cavanagh & Coffin, 1994; Ostmoe, Van Hoozer, Scheffel, & Crowell, 1984; Griggs, Griggs, Dunn, & Ingham, 1994; and Thompson & Crutchlow, 1993). Three articles in nursing were designed to see if students' learning styles changed over time or with changes in content (Wells & Higgs, 1990; Rakoczy & Money, 1995; and Stutsky & Laschinger, 1995). Teaching styles were also examined in relation to academic success.
(Goldrick, Gruendemann, & Larsen, 1993; and Marshall, 1991).

The information technology literature was mainly focused on the newer, upcoming technologies including videodisc technology (Billings & Cobb, 1992), digital imaging (Gore, 1992), computer simulations (Anderson, 1993), animation (Nicholls, Merkel, & Cordts, 1996), the Internet (Klatt, 1996; Collis, 1996; and Amra, 1997), and interactive multimedia (Kaplan, 1997). There were some studies which examined the use of technology in the classroom, but this was usually in the context of teacher education (Balli & Diggs, 1996; Faison, 1996; Hurst, 1994; Ingram, 1994; and Rodriguez, 1996). One study looked specifically at computer use in the classroom and focused on anxiety levels with technology (George, Hons, Sleeth and Pearce, 1996). Other factors such as age (Morris, 1996), gender (Morris, 1996), attitude (Billings & Cobb, 1992; Brudenell & Carpenter, 1990; and Delcourt & Kinzie, 1993), and academic achievement were also studied (Billings & Cobb, 1992). One article looked at using computers (specifically multimedia programs) to address diverse learning styles in a chemical engineering class (Montgomery, 1995). However, these studies focused on the student, not the instructor as proposed in this research.
Brain Hemispheric Preference

Brain hemispheric preference deals with the dominance of either the left or right side of the brain in thought and action. According to Eubank & Sparks (1993),

The two hemispheres are believed to process information and sensory stimulation differently. The left hemisphere generally processes input which is sequential, analytical, and more logical in nature, while the right hemisphere processes stimuli which can best be addressed via a random or holistic and more global approach in processing. (p. 22)

According to McCarthy (1990), Bogan’s research on the brain, “... has found that (1) the two halves of the brain process information differently; (2) both hemispheres are equally important in terms of whole-brain functioning; and (3) individuals rely more on one information processing mode than the other especially when they approach new learning” (p. 32).

Learning Styles

An abundance of information was found in the literature concerning learning styles. Studies have been conducted on students of all ages in a variety of classroom settings. However, it is difficult to compare and contrast the research findings on this topic due to the number and variance of learning style theories.

Gregorc (1982) categorized students as Concrete Sequential, Concrete Random, Abstract Sequential, and
Abstract Random. In a study performed by Wells & Higgs (1990), they cited that,

According to Gregorc (1982), the Concrete Sequential learner is methodical, structured, and prefers a step-by-step progression when assimilating new material. The Concrete Random learner is intuitive and impulsive, requires personal proof when validating new material and orders new material in a three dimensional type pattern. Abstract Sequential learners order material in a two-dimensional manner and tend to be logical, intellectual, and rational. . . Abstract Random learners are emotional and imaginative. Ordering of information proceeds in a random, nonlinear fashion, and attention is focused on personal relationships (p. 386).

According to Kolb (1984), there are four types of learners: diverger, assimilator, converger and accommodator. These types are determined by how the learner perceives and processes information. Kolb theorized that perception may be concrete or abstract and processing information may be active or reflective. The four different styles are classified as follows: diverger - concrete/reflective, assimilator - abstract/reflective, converger - abstract/active, and accommodator - concrete/active.

McCarthy’s (1990) approach to learning type is unique in that McCarthy uses a broad base from which to draw conclusions regarding how individuals perceive and process information. She uses Kolb’s work as part of that foundation, then builds on that with concepts from the fields of education, neurology, management and psychology.
She takes the two axis of Kolb's work (processing and perception) and creates a four-quadrant learning style model. Her premise is that each individual has a preferred way of taking in and processing information, thus their preferred learning style. Individuals who fit in Quadrant 1 are 'imaginative learners'. They need to know WHY they have to learn things, and they like to work in groups. Individuals who fit in Quadrant 2 are 'analytic learners'. These students often excel in school because they enjoy rote memory work and thrive on facts and figures. They are often solitary learners and search diligently for the WHAT in life. Individuals who fit in Quadrant 3 are 'commonsense learners'. They enjoy hands-on types of activities and like to know HOW things work. Individuals who fit in Quadrant 4 are 'dynamic learners'. They don't mind learning the why, what and how but they mostly enjoy taking their learning to another level and ask IF. Although most learners often fit into one quadrant or another, it is important to note that one is not better than another, it is just different. Each individual is unique and will show a preference for one quadrant over the others, however, each person has traits of all four quadrants to some extent.
Learning Style Inventories

A plethora of studies have been performed to assess learning styles among students of all ages. The field narrowed somewhat when searching for studies dealing with higher education. There was no single inventory that was preferred or used consistently in the research.

Types of Inventories

A researcher in the field of chemical engineering employed Soloman's Inventory of Learning Styles. In order to choose a preferred tool, Montgomery (1995), gave three inventories to a sample of eight students and gathered their input. The consensus was that Kolb's Learning Style Inventory (LSI) was, "... too laden with jargon and hard to answer" (p. 1) and the Myers-Briggs inventory was not a measure of learning style but rather of personality types. Solomon's inventory, however, was perceived as easy to use and more directed toward the research intent of the author. Montgomery utilized the results of the Solomon inventory to assess the ability of multimedia to meet the needs of the different learning styles of her students. She concluded that multimedia did contribute to positive learning experiences for the students in her study.

In nursing there were many studies done on student learning styles and most of them were performed using Kolb's LSI (Cavanagh et al., 1995; Goldrick, et al. 1993;
Haislett et al., 1993; Joyce-Nagata, 1996; Merritt, 1983; Rakoczy, & Money, 1995; and Stutsky, & Laschinger, 1995). Some of the exceptions included the following learning style tools: Canfield's learning style instrument (Merritt, 1983); Gregorc's Style Delineator (Wells & Higgs, 1990); and the Test of Cognitive Style in Mathematics (Bath & Blais, 1993).

Although many articles pointed toward the use of Kolb's LSI, Kolb's original LSI was questioned over validity and reliability. Kolb addressed those concerns by revising and updating the tool in 1985 (Atkinson, 1991; Cornwell & Manfredo, 1994; and Haislett et al., 1993) which has since been recognized as better defined (Cavanagh, et al., 1995; and Rakoczy, & Money, 1995). According to Haislett, et al. (1993), "Smith and Kolb (1986) report internal consistency coefficients (Cronbach's alpha) ranging from .73 to .88 (M = .81) for the revised LSI" (p. 66). However, DeCoux (1990) examined the application of Kolb's LSI (both versions) in nursing research and found them to come up short. She indicated that the test-retest on the LSI-1985 was actually lower that the original tool. In her conclusions, DeCoux (1990) firmly recommended against using Kolb's LSI in nursing research.
Cornwell & Manfredo (1994) stated that, "The use of nominal-level analysis of four primary learning styles (PLS) (i.e., doing, thinking, watching, and feeling), based on the LSI demonstrated their discriminant/ convergent validity but not the validity of Kolb's learning style types (LST) (i.e., accommodator, diverger, converger, and assimilator)" (p. 317). Atkinson (1991) also concluded in his research that the LSI was weak and needed further revision. Stutsky & Laschinger (1995) found inconsistencies in the results of learning style categorizations of baccalaureate nursing students when they administered both the 1985 and 1974 editions of Kolb's LSI. Other authors who were critical of Kolb's work were listed by Sutcliffe (1993), and Cornwell & Manfredo (1994).

Only two studies were found on learning styles in allied health. Katz and Heimann (1991), examined the learning styles of Israeli students and practicing health professionals in five different fields: occupational therapy, social work, nursing, physical therapy, and clinical psychology. Their findings concluded that there was variation between the groups, especially between students and practitioners.

Only one study concerning allied health was found that also included clinical laboratory science (Vittetoe & Hooker, 1983). The researchers utilized the Learning
Preference Inventory (LPI) designed by Rezler and French. This study identified the learning styles of students studying to teach in the health occupations field. There were eight medical professions represented in the sample (nursing, laboratory science, radiology, respiratory therapy, physical therapy, dental hygiene, dental assisting, and other health). A small group of non-medical students was also included in the study. The LPI was utilized in the study because it was designed specifically for use with allied health students. According to Vittetoe & Hooker (1983), Rezler and French studied the learning preferences of allied health students by designing an instrument that reflected three bipolar dimensions: (1) the abstract/concrete dimension, which deals primarily with learning preferences in the cognitive and psychomotor domains; (2) the individual/interpersonal dimensions; and (3) the student-structured/teacher-structured dimensions, which deal with aspects of the affective domain in learning preferences. (p. 50)

Another study initially looked to have studied learning styles in CLS students (through use of the Group Embedded Figures Test) and academic achievement. However, the article contained mostly history and definitions, and remarked in the last paragraph that the study was in progress and would be published at a later date (Powell, 1995).
Discussion of Selected Learning Style Inventories

As previously stated, there were many inventories used in the massive research done on learning styles. The one tool that was mentioned repeatedly was Kolb's LSI. According to DeCoux (1990), "The original LSI was a nine-item self-descriptive questionnaire developed by Kolb as a means to measure individual learning styles based on experiential learning theory" (p. 203). Following mixed reviews of the instrument in the literature, Kolb revised the inventory in 1985. In a review of the LSI by Atkinson (1991), he notes that the major change in the new instrument was the format. He explained further that, "The new instrument (LSI-1985) now has 12 items instead of 9. Rather than single adjectives, respondents must rank four sentence-completions for phrases such as 'When I learn...' or 'I learn best from...' to describe their learning preferences" (p. 157).

Many of the other learning style instruments found in the literature were used significantly less than Kolb's LSI. However, they merit examination. Merritt (1983) used a form of Canfield's learning style instrument (1980) as well as a portion of Kolb's LSI (1979) in her researcher-designed instrument. According to Merritt, Canfield defined four modes of learning,
. . . (1) listening - desire to learn through hearing content presented; (2) reading - desire to learn through examining print media; (3) iconics - desire to learn through viewing content presented in media such as slides and films; and (4) direct experience - desire to learn through handling content-related material or active participation in exercises (p. 368).

Montgomery (1995) employed Solomon's Inventory of Learning Styles with engineering students. This inventory consisted of 28 questions and classified individuals as to processing (active or reflective), perception (sensing or intuitive), input (visual or verbal) and understanding (sequential or global).

Wells & Higgs (1990), used Gregorc's Style Delineator to determine the dominant mind styles of nursing students. According to the researchers, "... individual learning styles are divided into four categories: Concrete Sequential, Concrete Random, Abstract Sequential, and Abstract Random" (p. 386).

Learning Style Research in Nursing and Allied Health

Although there was only one study found in clinical laboratory science on the topic of learning styles (Vittetoe & Hooker, 1983), there were many published in nursing, specifically in nursing education. Merritt (1983) examined learning style preferences of baccalaureate nursing students. Four-hundred sixty-six students enrolled in upper-level nursing courses were given the Learning
Styles Questionnaire (LSQ). This instrument was designed by the researcher and contained portions of Kolb's LSI (1979) and Canfield's learning style instrument (1980). Results of an analysis of variance indicated there was no difference in learning styles by students' age or work experience. However, a significant difference was found in the overall preferred learning style. On the Kolb portion of the inventory, Tukey tests indicated that students preferred the reflective observation scale over the other three scales (concrete experience, abstract conceptualization, and active experimentation). The researcher also noted a significant difference in the preferred learning style on the Canfield portion of the inventory. According to Merritt (1983),

Results of the paired comparisons for the Canfield model revealed that the mean scores for the learning style scales differed significantly from each other except for the following paired comparisons: structure and direct experience, affiliation and iconics, iconics and listening, and listening and achievement (p. 370).

Wells & Higgs (1990), studied first and fourth semester baccalaureate nursing students to determine if there were differences in the learning styles of the two groups and if their learning style changed over time. One-hundred twenty-nine junior and senior students volunteered for the study. The Gregorc Style Delineator was employed to identify the students' dominant mind style.
The major learning styles of the first semester students were Concrete Sequential and Abstract Random. The major learning styles of the fourth semester students were Abstract Random and Concrete Sequential. According to the Chi-square analysis, there was no significant difference between the two groups. Only 30 of the original 129 students completed the study from the first semester through the fourth semester. Paired t-tests indicated no significant change in the students' learning style over the four semester period.

Goldrick, et al. (1993), examined learning styles among three groups of nursing professionals in the following areas: critical care, the operating room, and infection control. Three individuals (one from each group) were chosen at 12 hospitals from each of nine regions nationally. This yielded a sample of 324 nursing professionals. Kolb's LSI (1985) was employed along with the Learning Strategies Preference Questionnaire (LSPQ) by Ostmoe et al. (1984). The results of the LSI indicated that the largest percentage of professionals were assimilators. According to the results of a Chi-square analysis, there was no significant difference in the preferred learning style of the three groups of professionals. Further study indicated no significant difference in teaching/learning strategies with the
variables of age, sex, education, length of time in specialty, amount of experience, educational level, type of facility or geographic region. One significant finding, however, was the negative relationship found between age and preference for self-directed teaching/learning strategies (p. 180).

Bath and Blais (1993), examined the mathematical abilities of nursing students in relation to their learning style. Sixty-six nursing students were studied following their first semester in nursing school. The Test of Cognitive Style in Mathematics (cited in Bath & Blais) was given to determine the students' learning style in math. According to the researchers, "Most students (55/66; 83%) displayed inchworm, sequential, step-by-step, paper and pencil mathematical strategies" (p. 34). Following administration of the math style inventory, a mathematics exam was given dealing with the calculation of drug dosages. A significant correlation was found to exist between the learning score in mathematics and performance on the drug calculation score. The 'inchworm' learners tended to do poorly on the exam, the 'integrated math processors' did some better, while the 'grasshopper' (or global, all-at-once, mental processors) did the best (p. 35).
Haislett, et al. (1993), studied first year baccalaureate nursing students to determine if there was a relationship between their learning style and academic success (measured by grade point ratio, study behavior and attitude). One-hundred freshman nursing students volunteered for the study. Following the use of Kolb’s LSI (1985), 74% of the students were classified as assimilators and divergers, whereas 26% were classified as accommodators and convergers. An analysis of variance indicated that the assimilators and divergers were most successful academically. The least successful group were the accommodators. No significant difference was found among the students’ learning style and their study behavior or attitude.

A longitudinal study of learning styles in nursing students was performed by Rakoczy and Money (1995). One-hundred seventy-six first year nursing students were originally given Kolb’s LSI (1985) to determine their learning style. The same group was tested in their second and third years of nursing school. The dominant learning style of the group was assimilator. According to the results of the analysis of variance, there was no significant difference found among the group over the three years.
A study was performed by Cavanagh et al., 1995, to assess learning styles of nursing students and determine if there was a relationship between learning styles and age, gender, educational attainment, and previous work experience. One-hundred ninety-two nursing students were included in the study. The researchers employed Kolb's LSI (1985) to identify the students' learning styles. According to Cavanagh et al., "The percentage of students having a predominantly concrete learning style accommodator + diverger scores) was 53.7% while 46.3% were predominantly reflective (assimilator + converger scores)" (p. 180). Chi-square analyses found there was no significant relationship between learning styles and the variables of age, gender, educational attainment, and previous work experience.

Stutsky and Laschinger (1995) studied nursing students in a senior preceptorship program looking for possible changes in learning styles before and after the experience. Thirty-seven senior baccalaureate nursing students were given Kolb's LSI (1985) to determine their learning styles prior to the preceptorship and following the preceptorship. The predominant learning style prior to the preceptorship was that of assimilator, whereas, converger was the predominant style following the preceptorship. However, according to a Chi-square analysis, there were no significant differences found in the preferences either
before or after the preceptorship (both were considered abstract learners). The classifying of nursing students as predominantly abstract learners did not match previous research so the authors of this study also gave the students the 1974 version of Kolb's LSI following the preceptorship. Results of the second tool did find that more students were classified as concrete learners which was more consistent with the previous research.

Joyce-Nagata (1996) examined learning styles of students and educators in the field of nursing. Three-hundred fifty individuals were studied in the following groups: nurse educators in a baccalaureate nursing program (n = 19), traditional baccalaureate nursing students (n = 229), registered nurse baccalaureate students (n = 42), and non-nursing baccalaureate students (n = 60). Using Kolb's LSI (1985), students and teachers were classified as to their learning style. The distribution was the following: 41.64% Assimilators, 17.28% Convergers, 17.28% Divergers, and 23.8% Accommodators (p. 71). According to the results of an analysis of variance, there were no significant differences in the preferred learning style among the different groups of students. Educators were not included in the study due to a low number of participants. There was also no significant difference
found in an analysis of covariance when the researcher matched student learning styles with teacher's styles.

Two studies were found on learning styles in the allied health field. One article discussed the evaluation of learning styles in both students and practitioners in Israel (Katz & Heimann, 1991). Individuals from five health professions (n = 629) were studied which included occupational therapy, social work, nursing, physical therapy, and clinical psychology. Kolb's LSI (1976,1984) was used to identify learning styles among the students and practitioners. A one-way analysis of variance indicated that there was a significant difference among the groups. A Scheffe test further identified that, "... physical therapy students had significantly less emphasis on the concrete scale as compared to the other students" (p. 242). The comparison of students to practitioners showed that there was much more variance in the student population than that of the practitioners.

Vittetoe and Hooker (1983) studied 302 teacher education students in various health fields over a three year period. The researchers utilized the Learning Preference Inventory designed by Rezler and French (1975). This study identified the learning styles of experienced professionals who were studying to teach in the health occupations field. There were eight medical professions
represented in the sample (nursing, laboratory science, radiology, respiratory therapy, physical therapy, dental hygiene, dental assisting, and other health). A small group of non-medical students were also included in the study. The results indicated that over half of the students in all nine occupational groups scored higher on the concrete scale. Also, according to the analysis of variance, no significant difference was found among the groups on the variables of sex, standing, location, or teaching experience.

**Learning Styles and Computers**

Brudenell & Carpenter (1990), conducted a study concerning adult learning styles and attitudes toward computer assisted instruction (CAI). They gave a pre-test on attitudes toward CAI and a learning style inventory (Kolb’s 1976 LSI) to a single group of 40 students, then gave a nursing CAI program to use, followed by a post-test to the same group of students. After looking at learning styles and the pre- and post- attitude tests, they concluded that all students had a lower score which indicated a poorer attitude toward CAI following the intervention. They recognized, however, that the results were limited in generalizability due to the small, non-randomized group utilized for the study. Also, they noted
that the attitudes may have been influenced by the CAI program itself.

A study conducted in chemical engineering by Montgomery (1995) utilized multimedia programs to address students' different learning styles. Montgomery discussed the benefits to learners in the following categories: processing (active/reflective), perception (sensing/intuitive), input (visual/verbal), and understanding (sequential/global). She found that active learners benefitted from the interaction of the programs and reflective learners were more responsive to a movie incorporated to demonstrate a temperature experiment. The sensing learners found the interactive simulations and demonstrations to be helpful. Visual learners appeared to benefit the most from graphics, movies, and animations incorporated into the programs. The programs also attempted to place the didactic material into an ordered, global format to appeal to sequential/global learners.

Research conducted by Yoder (1994) examined preferred learning style and student achievement based on linear video and computer-assisted interactive video instruction (CAIVI). A pre-test was given to 58 volunteer baccalaureate nursing students. Following the intervention, a post-test was given to the same group of students. The learning style inventory (Merritt and Marshall Learning Style
Questionnaire) had been given earlier in the semester. Since the group was non-randomized, the pre-test was used to establish equivalency among the students in the study. A two-way analysis of variance (ANOVA) was used to determine if there was a difference in the four learning style groups and the mean scores on the post-test. Results of the ANOVA showed a statistical difference between the four groups as well as an interaction between the learning style and the treatment. The observation made by the researcher was that, "Learners who preferred to learn by active experimenting learned better with CAIVI; learners who preferred to learn by reflective observing learned better with linear video" (Yoder, 1994, p. 131).

Another study utilizing computer assisted interactive videodisc instruction was conducted by Billings and Cobb (1992). The authors used a pre-test, intervention, post-test design with a sample of 47 baccalaureate nursing students. Other information gathered included demographics (age, type of student, ethnic status, gender, hours of employment and course failure history), learning style (using Dunn, Dunn, & Price's PEPS), and attitude toward computer-assisted instruction (using the Allen Attitude Toward CAI Semantic Differential Tool). Three pairs of variables were analyzed, using Spearman's rho, to determine if there were existing relationships between them. The
variables were: 1) learning styles and attitude toward computer assisted videodisc instruction, 2) attitudes toward computer assisted videodisc instruction and the post-test scores, and 3) learning styles and the post-test scores. Also, grade point average (GPA) was added into the mix and a regression analysis was performed. The authors found significant relationships between the learning style subscales and attitudes toward computer-assisted interactive videodisc instruction (CAIVDI). In the regression analysis, comfort (a subscale of the attitude scale) was positively correlated with achievement on the post-test. However, no significant difference was found between learning styles and achievement on the post-test.

**Factors Influencing Computer Use**

Age may be considered a factor when examining computer use. Morris (1996) studied 422 older adults and their ownership/use of computers. He found that three factors had an effect on computer ownership and usage in older adults: level of education, age and sex. Goldrick et al., (1993) studied learning styles and teaching/learning strategy preferences in nurses working in critical care, the operating room, and infection control. Using Kolb's LSI (1985), the Learning Strategies Preference Questionnaire (LAPQ), and a demographic questionnaire, they searched for differences among the three groups. The only
significant results they had were concerning age and teaching/learning strategy preferences. They found that the younger respondents (age < 40) significantly preferred live demonstration, clinical practice, case studies, simulation, computer-assisted instruction and student-lead seminar when compared to the respondents over the age of 40.

Collis (1996), an educator in the Netherlands, purposed a "3-P Model" which may explain the extent that a teacher will embrace informational technology in the classroom. A comparison of computers in education in the early eighties (First Wave) and the Internet in education around the mid nineties (Second Wave) was made. Collis stated, "The 3P Model says that the vector sum of Payoff, Problems, and Pleasure must be sufficiently positive in order for usage to occur" (p. 25). Her observation was that the first wave of computer usage in the classroom was not as effective as first predicted with mixed payoffs, many problems and more stress than pleasure for educators. However, her prediction for the second wave was much more positive. The author stated, "... the unique characteristics of the World Wide Web, coupled with differences in society compared to a decade earlier, suggest that certain breakthroughs in implementation success will occur in this second wave" (p. 21). The
summary of her work included five lessons learned from working with computers in education: 1) Begin with teachers' own classroom problems and concerns; do not begin with the technology or its promise; 2) Anticipate the need to demonstrate some sort of meaningful effectiveness, fairly quickly; 3) Make it as easy as possible for teachers to use the Internet in the trigger-event context; walk through each step of the process with a teacher for him or her to make use of the WWW in the classroom; 4) Consider not putting the school computers only in a computer room, but instead look to the ideas of a "portable" computer room. . . ; 5) Support the enthusiasts; it is their energy which will stimulate creative applications and overlook frustrations (pp. 29-30).

According to Hope (1996), there were five factors that need to be present for teachers to embrace technology in the classroom: 1) ease of implementation, 2) access to computer technology 3) collaboration, 4) training and 5) sufficient time. He concluded that, It is prudent neither to leave it to teachers to make the decision about using computer technology nor to force them to use it. However, when the factors listed here are present in a school, the likelihood of teachers becoming users of computer technology increases. (p. 107)

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Computers in Clinical Laboratory Science Education

Computers are used in CLS education for many tasks. Initially computers were used as glorified typewriters by staff and faculty to facilitate clerical duties. As technology progressed, the potential was recognized for using computers in both classroom and student laboratory settings.

Gore (1992), introduced the concept of digital imaging in medicine. The information presented dealt with utilizing digital imaging in radiology and pathology, however, she also mentioned the use of images on videodisc in urinalysis. Applications of digital imaging to clinical laboratory science education were discussed including computer tutorials utilizing videodiscs, CD-ROMs, and multimedia authoring tools.

A tutorial for teaching coagulation disorders was designed by Nguyen & Uthman (1994). The program, XPCOAG, was set to give students initial data concerning a patient's laboratory results. The student could either select a differential diagnosis based on the laboratory values or choose to view supplemental information. The student finally would be directed to select a suspected disorder and the program would give the answer written into the program. The XPCOAG program was validated through the use of case studies gleaned from a textbook.
Another tutorial published in 1994 was developed by Cookson, et al. The GramStain-Tutor was based on digitized images of bacteria taken from a variety of focus points and angles. To establish validity, 20 medical technologists reviewed the initial program. According to the authors, the most positive feature of the program was its ability to engage the student in quality learning with little input from an instructor. However, the biggest drawback was the requirement of high level computers to be able to properly display the images. The GramStain-Tutor has become a well respected program which has even been recently discussed on an international clinical laboratory educator's electronic listserve.

Wiggers and Hicock (1996) developed a computer program to assist in student self-instruction and evaluation in the area of laboratory mathematics. The program was intended for, "...remediation of CLS students with deficiencies in the performance of basic laboratory calculations" (p. 223). Following preparation of the computer-adaptive testing program, the authors conducted a three-year study of student attitudes and performance following use of the program. They found student attitudes to be positive and performance to be increased following use of the program. The computer-adaptive program was designed to replace traditional didactic review of mathematical concepts with
results of the study confirming its usefulness. Wiggers (1996) also developed a computer database program to facilitate student review of hematology slides. The educator would be able to create a file of blood slides including a unique identification number, pertinent hemogram information, differential percentages, red blood cell morphology, and diagnosis. Students were able to use the computer to enter their data during student lab exercises which could be later evaluated by the instructor. Both student and faculty evaluations were positive about the program.

**Training Teachers in the Use of Information Technology**

Information technology has been the subject of much research. In education, the focus of most articles concerning its use in the classroom dealt with either the anxiety of teachers toward computers or the need for training. Many authors concluded that training was a pivotal issue to get teachers to begin using information technology in the classroom (Balli & Diggs, 1996; Faison, 1996; Hope, 1996; Hurst, 1994; Ingram, 1994; Levin & Thurston, 1996; and O’Neil, 1995). According to Balli & Diggs (1996), “The most advanced educational technology is of little consequence without teachers who can integrate the technology confidently and appropriately into a lesson” (p. 61). This sentiment was echoed by Hurst (1994),
As a colleague recently told me, computers are nothing more than a new kind of chalkboard, a tool to help teachers make their instruction more effective and learning more inviting for a generation weaned on Nintendo, VCRs, and home PCs. But enticing teachers to chuck the chalk and pick up the mouse is not always simple. If teachers are to use technology effectively in their classrooms, we must meet their needs for adequate in service training programs. (p. 74)

Faison (1996) also recognized the need for teacher training when she stated, "While many barriers to technology use exist (i.e., resources, time), most disturbing is the fact that many practicing teachers felt that they have not had adequate training to help them use technology effectively (p. 57)". Although many articles reviewed were focused on secondary education, Faison addressed faculty in higher education. She admonished faculty to address technology for both teaching and learning. Ingram (1994) also included higher education when she stated, "Thus teacher education is the potential hot button, the catalyst for change, the means of initiating a process wherein technology-augmented teaching will infuse all aspects of formal education, from K-12 through higher education, with the result that students learn more, learn better, and do it faster at cheaper and steadily declining cost" (p. 116).

According to Hurst (1994), teachers should be proficient with word processing, databases, spreadsheets, desktop publishing, electronic communication and
multimedia. Levin & Thurston (1996) supported the need for teaching training in telecommunications (electronic communication). Delcourt & Kinzie (1993), suggested the use of word processing, electronic mail (e-mail), and data bases on CD-ROMS are the most important areas for teacher training.

**Teaching Styles**

Emphasis on teacher education leads us to examine teaching styles also. According to an international article by Catt & Eke (1995), one of the most important issues in teaching was classroom talk. The use of information technology wasn't discussed, except in the context of audio and video taping lectures given by student teachers in class to review their performance. According to their research, the three most common problems with classroom talk (which this author interpreted as lecturing) was misunderstanding, participation in exploratory talk, and classroom discourse.

According to Grasha (1994), a study of learning styles together with examining teaching styles can lead to a better understanding of the effectiveness of instruction. He identified five distinct teaching styles: expert, formal authority, personal model, facilitator, and delegator. However, as is the case with learning styles, teachers shouldn't be pigeon-holed into a particular style
but rather allowed to combine styles depending on the circumstances and nature of the class. Grasha discussed 'blends' of the different teaching styles which he defines in four clusters: CLUSTER 1 - expert/formal authority, CLUSTER 2 - expert/personal model/formal authority, CLUSTER 3 - expert/facilitator/personal model, and CLUSTER 4 - expert/facilitator/delegator. Also, he discussed how teachers may modify their teaching styles and move from one cluster to the next to be more effective in their instruction.

Researchers also examined matching student's learning styles with the instructor's teaching style through a literature review (Cavanagh, & Coffin, 1994). The study focused on nursing and health education, although some literature reviewed was directed toward primary and secondary education. The overall conclusion was that, "The research evidence for improved performance based upon matching the learning styles of student and teacher remains inconclusive" (p. 108). They did note, however, that the age of the student may influence learning and recommended that a variety of teaching styles be used in classes with a wide age range.

A different approach to examining teaching styles was taken by Trigwell & Prosser (1996) when they looked at the intention and strategies of university science teachers.
Through a quantitative study of interviews with science teachers they determined four intentions and three strategies in teaching: Information Transmission Intention, Concept Acquisition Intention, Conceptual Development Intention, Conceptual Change Intention, and Teacher-focused Strategy, Student-teacher Interaction Strategy and Student-focused Strategy. A series of correlations were run that identified relationships between teacher intentions and strategies. There was a positive correlation with Information Transfer Intention and Teacher-focused Strategy. Also there was a positive correlation with Conceptual Change Intention and both Student-Teacher Interaction Strategy and Student-focused Strategy. According to the authors, "The implications of these results for academic development is that just helping academic staff become aware of, or even practicing, particular strategies will not necessarily lead to substantial changes in teaching practice. The associated intentions or motives also need to be addressed" (Trigwell & Prosser, 1996, p. 85).

Varieties of Information Technology Application

One application of information technology is educational electronic networks. According to Levin & Thurston (1996), "Electronic learning networks provide access to the riches of the world. . . students and
teachers anywhere can communicate with content-area experts from around the world“ (p.46). They also intimated that students performed better in class once motivated by the interaction with others via the network (i.e., the Internet).

Multimedia presentations were another type of information technology application. According to Kanning (1994), “Though teachers around the country are using multimedia technology in different ways, the approach is most successful when it helps students reach existing curriculum goals. As educators create effective uses for multimedia technology, imagination will be their only limit” (p. 44).

According to Shanley (1994), multimedia (in an interactive format) could be used to create an electronic curriculum. He pointed toward a need to exchange existing educational programs on an international basis. The author used the example of an electronic curriculum for oral health workers complete with programs on oral manifestations of human immune virus (HIV) infection and cross-infection control that is being used in Dublin. He also stated that, “In theory, an entire curriculum of multimedia programmes could be structured on this modular design but the immediate intention is to supplement existing curricula” (p. 27).
A unique innovation in computer use was simulations. Simmons & Lunetta (1993) explained how simulations can be used to guide students through genetic studies. Thomas and Hooper (1991) also advocated the use of simulations. They concluded that, "... (a) simulations are most effective when used before or after formal instruction, (b) the effects of simulations are not revealed by tests of knowledge but are revealed by tests of transfer and application, and (c) extensive research is needed on simulation design and use" (p. 497).

In CLS, simulations could be a very cost-effective way to give students certain clinical experiences in a student lab. According to Anderson (1993), "Simulations designed to place students and laboratory professionals in realistic settings are invaluable educational training aides" (p. 429). Anderson pointed out that simulations in the student laboratory could allow for student hands-on training without the risk of handling dangerous chemicals and biohazardous materials.

The Internet was also mentioned as an effective tool to use in the classroom. Klatt (1996) referred to the WWW, a component of the Internet, as an 'electronic city'. He listed the uniform resource locator (URL) addresses of several WWW resources for people in the clinical laboratory. These sites could be helpful both in the
laboratory and in the classroom. Some of the addresses were as follows: the National Institutes of Health (NIH) at http://www.nih.gov/; Martindale's Health Science Guide at http://www-sci.lib.uci.edu/~martindale/HSGuide.html; the Occupational Safety and Health Administration (OSHA) at http://www.osha.gov/; and the University of Utah WebPath Internet pathology Laboratory (Klatt, 1996, p. 121). Erbey, Evans, & LaPorte (1997) also advocated using the Internet in CLS education. Their outlook was global and they suggested sharing curriculum with educators around the world and working together to offer continuing education through the Internet. These authors recommended two Internet sites for clinical laboratory information: the American Society of Clinical Pathologists (ASCP) home page at http://www.ascp.org, and the Global Health Network home page at http://www.pitt.edu/~jreii/lab (Erbey, et al, 1997, pp. 59-60).

Kaplan (1997) continued the theme on the Internet in education. He called multimedia courses delivered via the WWW, "A new paradigm for university teaching and learning" (p. 48). He emphasized the variety of sensory input available through this medium which included streaming audio, animation, 3-D imaging and chatting. His examples of multimedia interactive courses on the WWW were related to physics but may be applied to virtually any subject.
Barriers to Use of Information Technology in the Classroom

In their research, Levin & Thurston (1996) report that the barriers to the use of electronic networks in the classroom include, "... lack of access and appropriate infrastructure, separation of telecommunications from the curriculum, lack of support for the teachers attempting to work with innovative approaches, and lack of teacher expertise in telecommunications" (p. 47). Also, a survey ("Technology forum", 1996) of principals, teachers and media coordinators indicated that, "[Eighty] percent of educators felt that lack of knowledge, training, time, or lack of access to proper equipment were barriers to greater use of computers, online services and the Internet..." (p. 8).

Another barrier to faculty use of information technology in the classroom was fear that the students will know more than they do about the technology or that the technology won't work and they will be embarrassed by their failure. George et al., 1996, referred to this as cyberphobia, defined as an aversion to technology (p. 605). They stated that administrators must, "... recognize that instructors may harbor some form of fear or anxiety to use technology in their classrooms where they are focus of the student's attention" (p. 604). However, according to Means & Olson (1994), "... it is not necessary for the
teacher to know everything about the tools that students use; students and teachers can acquire whatever technology skills they need for specific projects. In fact, one of the best things that teachers can do with respect to technology is to model what to do when one doesn’t know what to do” (p. 16).

Benefits of Information Technology in the Classroom

Initially computers had little effect on student learning in the classroom, due to their narrow scope—either tutorials or enrichment information packages. However, according to Means & Olson (1994), the explosion of multimedia applications has made an impact on student learning with a greater number of tools for both teacher and student application. Rodriguez (1996) helped define that impact when he pointed out the global value of computers through contact with experts from around the world via telecommunications.

According to Dede, in O’Neal (1995), “... emerging technologies can provide sustained support to teachers as they experiment with new ways of teaching and learning (p. 53)”. Levin & Thurston (1996) believed that the use of information technology in the classroom can have a profound effect on both teaching and learning, allowing the teacher to be more of a facilitator rather than just a lecturer.
This concept was echoed by Means & Olson (1994) when they said,

The efforts seek to move classrooms away from conventional didactic instructional approaches, in which teachers do most of the talking and students listen and complete short exercises on well-defined, subject-area-specific material. Instead, students are challenged with complex, authentic tasks, and reformers are pushing for lengthy multi-disciplinary projects, cooperative learning groups, flexible scheduling, and authentic assessments. (p. 16)

Peck and Dorricott (1994) pointed out specific factors that influenced the need to use technology in the classroom. These factors included, "... the different learning rates of each student, the need for information accessing and processing capability in today's workforce, and the need for schools to raise their productivity and efficiency" (p. 11).

The Internet can make a difference in the way teachers view the use of information technology in the classroom. According to Collis (1996), some teachers may not have embraced the computer in their classroom due to the inflexibility of prepackaged software and the difficulty in integrating it into pre-existing lesson plans. However, with the advent of the Internet, specifically the WWW, teachers can search out specific photos, text, videos, etc., to enhance any aspect of their prepared lessons. The WWW offers the teacher a plethora of information that can be tailored to their specific needs in the classroom.
Other benefits of using technology were identified by a survey (Educational technology survey, 1996) of principals, teachers and media coordinators which summarized that, "More than half of the respondents felt that online services and the Internet: *Prepare young people for the information age *Facilitate exchange of information between schools and learning centers *Support schools and teachers through community services and *Assist teachers' professional development" (p. 8). Rodriguez (1996) also recognized the benefit of professional development through information technology. The Internet was noted as an excellent resource for on-line courses, access to personal home pages that share curriculum and project information, and access to businesses that both share free resources on the Internet, as well as listing resources available for purchase through their business. List servers and bulletin boards were noted as another way to communicate with educators from around the world and many such services keep an ongoing list of professional development opportunities such as workshops, chats, Internet classes, etc.

Although the Internet may be viewed as a wonderful tool, it was not the only computer technology noted as making great strides in education. Multimedia has gone from a slide projector with a cassette tape to real-time
movies on the computer and animation. In their research on animation in microbiology, Nicholls, et al. (1996) stated,

Over the years of teaching introductory microbiology, the authors have found verbal, written, and static-diagram explanations of complex biological processes to be woefully inadequate. . . Animation has made it possible to paint a vivid picture of what components are involved, how they interact, and why they are important, giving students a better understanding of what is happening between and within living cells over time and space. (p. 359)

However, the results of their study of students studying with and without animated materials was mixed and they could not statistically prove that there was a difference in performance.

Siegel and Holzberg (1994) also advocated the use of multimedia in the classroom. These authors gave the example of a second grade teacher creating a multimedia program to illustrate the digestive system. After showing it in class, the students wanted to be involved in lending their own 'touch' to the presentation. They added photographs, sound and color to the program and discovered they were learning while they were having fun. If second graders can learn and have fun on such a program, how would a college junior react to having the tools to create an animation of leukocyte maturation from blast to neutrophil? As one trainer put it, "If they develop it themselves, they own it forever" (p. 31). This concept was supported by the following statistics provided by Ingram (1994), "It is
purported that students retain 10% of what they hear, 20% of what they see (traditional instruction), 50% of what they see and hear (multi-media), and 80% of what they see, hear, and do (multi-media interactivity)" (p. 115).

In summary, though there were many articles on learning styles, computer use in the classroom, learning style inventories, information technology, etc., there was a definite void in clinical laboratory education research on these topics. This review of the literature further strengthened the premise that the proposed research would add to the body of knowledge in clinical laboratory science.
CHAPTER 3

METHODOLOGY

Design

The study was designed as a survey to provide foundational information on CLS university-based faculty. The concept was to examine learning styles and their potential relationship to the use of informational technology in the classroom. Since this topic had not been previously explored in the area of CLS, the study was considered to be exploratory.

Population and Sample

In CLS education, there are university-based and hospital based programs. The university-based programs generally have a program director and one faculty member per major discipline: hematology, microbiology, chemistry and immunohematology. The classes are held in typical classrooms with access to university resources for information technology support. However, the hospital-based programs usually have a program director and fewer faculty members. The classroom is often a small room within the hospital somewhere close to the clinical laboratory with information technology support from the laboratory. Due to these differences, this research was focused on faculty within CLS university-based programs.
This decision allowed for a modicum of continuity in resources and faculty size.

A list of nationally accredited CLS (4-year) programs was obtained through the National Accrediting Agency for Clinical Laboratory Science (NAACLS). According to NAACLS, there was a total of 338 nationally accredited clinical laboratory science (4-year) programs, 135 of those programs being university-based in the United States (excluding the territory of Puerto Rico). The list contained the addresses for all the CLS programs, but a comprehensive list of faculty members at each institution did not exist.

The research to be conducted was directed toward individual educators therefore, it was necessary to develop a list of national university-based clinical laboratory science faculty. Initially, a request for faculty information was placed on a clinical laboratory educators' bulletin board on the Internet (see Appendix A). Twenty-one responses were received via e-mail or fax. Also, a list of faculty was obtained from a colleague at The Ohio State University, where they had recently completed a study on research productivity and activities of CLS university-based faculty. The lists from Ohio State and the Internet survey were collated to provide a complete population of 502 university-based clinical laboratory science faculty in the United States (excluding the territory of Puerto Rico).
This comprehensive list encompassed all NAACLs accredited CLS university-based programs in the United States. However, since hospital-based programs were not included, the following states were not represented in the study (due to the lack of university-based programs): Maine, Montana, Oklahoma, Rhode Island, and South Dakota.

A number for simple random sampling was calculated using Cochran's sample size determination formula (Cochran, 1977). The initial sample size recommended by Cochran's formula was 171. However, since the suggested sample size \( (n = 171) \) was more than five percent of the population \( (n = 502) \), a correction formula was employed to take into account the population; therefore, the sample size was decreased to 127. Based on input from educators in the field of clinical laboratory science, only a 60% response rate was expected with this population so the sample size was further manipulated for replacement by dividing the adjusted sample size by the expected response rate. The subsequent sample size adjusted for population and replacement was 212.

**Pre-survey Questionnaire**

A pre-survey questionnaire (via a return postcard) was sent to the selected sample \( (n = 212) \) of faculty members because of discrepancies between the two lists identified above, and timing of the survey (to be conducted during the
The pre-survey questionnaire was sent prior to the study for the purpose of verifying summer addresses (some clinical laboratory science faculty are on nine-month contracts) and for seeking their willingness to participate. The pre-survey questionnaire also confirmed the frame by resolving conflicts between the Internet and The Ohio State University lists. The letter and reply postcard may be found in Appendix B.

**Instrumentation**

A learning style inventory and an information technology survey instrument were needed to meet the objectives of the study. There were many commercial learning style instruments available for research use (e.g., Kolb’s LSI, McCarthy’s LTM, and Dunn & Price’s LSI). McCarthy’s Learning Type Measure (LTM) was chosen for use in the study due to its holistic approach and its application to teachers. According to McCarthy, Lieberman & St. Germain (1993), “. . . the LTM reflects individual preferences for attending to, acting upon, and creating representations of knowledge and experience” (p. 2).

The LTM is a 27-item self-assessment inventory (see Appendix C). Part A contains 15 questions designed to indicate participant preferences in attending to, and acting on, what they learn. Part B contains 12 questions directed toward a participant’s tendency to be a watcher or
doer. In order to determine the scores for each quadrant of learning, only Part A was utilized. Each tool can be scored to determine the scores for each quadrant: Type 1 - imaginative learners, Type 2 - analytical learners, Type 3 - common sense learners, or Type 4 - dynamic learners. Statistical analyses was performed using both the highest scored (preferred) quadrant and the lowest scored (least preferred) quadrant. The high and low preference scores were used upon recommendation by the authors of the LTM instrument (McCarthy et al., 1993).

Only one information technology survey was found after a thorough searching of the literature. However, that survey was deemed inappropriate for this study because it was a phone survey directed at K-12 educators and principals concerning information technology with an emphasis on the program, Cable in the Classroom (Faison, 1996). Therefore, it was necessary to design an information technology instrument to focus on quantitative data to support the objectives of this research. The variables included in this researcher designed instrument were various information technology tools and the amount of time they are used by the professor in the classroom. The tools studied were as follows: audio cassette player, 35-mm slide projector, 35-mm slide projector with tape player, VCR player, laser disc player, CD player (sound only),
satellite conferencing, compressed video (for distance learning), computer with large monitor, computer with projected image, instructional CDS, CD databases, graphics in presentations, sound in presentations, real-time videos in presentations, computer videoconferencing, e-mail, and Internet (WWW). The selections were based on the literature and the researcher’s experience in the classroom. Care was taken to include all types of media, not just the high-end technology. Definitions were added to the last page of the inventory to give guidance to faculty in reporting their answers. Additional potential explanatory factors of age (Goldrick, Gruendemann, & Larsen, 1993; Morris, 1996), gender (Ayersman & Reed, 1995-1996; Morris, 1996), level of education (Morris, 1996), and major discipline (Goldrick, Gruendemann, & Larsen, 1993) were included in the instrument following a review of the literature. A copy of the instrument may be found in Appendix D.

Validity and Reliability

In order to determine face validity of the researcher-developed information technology use instrument, the tool was given to six CLS educators who were not included in the selected sample and a panel of university faculty. A final instrument was developed based on the responses. A reliability coefficient was calculated which resulted in Cronbach’s alpha of 0.83.
Content and construct validity of the Learning Type Measure (LTM) was initially determined based on administration of the LTM to 390 people attending a workshop on the 4MAT system (a way of teaching designed by McCarthy that incorporates all four learning styles into the instruction methodology). According to McCarthy, et al., 1996, "The stems in the 15 items of Part A represent the descriptions of the four types of learners found in several books and articles by Dr. McCarthy and her colleagues. Therefore, the measure has content validity, since the items represent those four styles" (p. 8).

According to the LTM Presenter’s Manual, construct validity of the LTM has been determined through the way the LTM is scored, the frequency distribution of learning types, and the difference between the maximum and the next highest sum (McCarthy et al., 1996, p. 8). Concurrent validity was established between the LTM and both Kolb’s LSI and the Myers Briggs Type Indicator (MBTI). Cronbach alpha coefficients were used to assess the internal consistency of the four scales in Part A of the instrument (McCarthy et al., 1996, p. 11). The coefficients were as follows: Learning Type One - 0.853; Learning Type Two - 0.835; Learning Type Three - 0.767; and Learning Type Four - 0.885. The reliability for Part B, “doing” versus
"watching", was 0.863. Further studies yielded a test-retest coefficient of 0.71 (McCarthy et al., 1996, p. 11).

Part A of the Learning Type Measure was the only data used in this study to ascertain learning types. To determine the coefficients of internal consistency, Cronbach alphas were calculated independently for each quadrant of learning type. In each of the fifteen items on the inventory, the participant was asked to rate each item as being 4 - most like them, 1 - least like them, and 2,3 somewhere in between. Then the scores for each item, which would discriminate between the different types of learners, were collated for each participant and internal consistency calculated. For example, the computer was given the pattern of answers that would identify a respondent as a Quadrant One learner (i.e., la, 2d, 3c, 4a, etc). Then the scores of those items were collated by the computer and a Cronbach alpha was calculated for the entire sample for that quadrant. This process was repeated for the other three quadrants. The Cronbach alphas for Part A and the four learning types using the CLS study data (n=145) were as follows: Learning Type One - 0.799; Learning Type Two - 0.753; Learning Type Three - 0.657; and Learning Type Four - 0.788. These values were very comparable to the published data reported on the previous page.
Data Collection

A packet of information was sent to each of the faculty in the sample following the collation of information from the pre-survey questionnaire. The original sample was 212, however, there were 12 who replied that they could not participate so the final sample was 200. The packet included the following: a letter asking assistance with the study (see Appendix E), a copy of a research form of the Learning Type Measure (permission granted by Excel, Inc., see Appendix C), a copy of the information technology use instrument, and a self-addressed, stamped reply envelope. Each participant was assigned a record number, that was placed on the LTM and information technology instrument, to maintain confidentiality. The packet was sent to the individuals in the sample on June 23, 1997. A reminder card was sent to non-respondents on July 17, 1997 (see Appendix F) and second packet of information was sent on August 18, 1997 (see Appendix G). A follow-up of the remaining non-respondents was conducted late August through early November, 1997, using phone interviews, facsimile correspondence, and responses received after August 29, 1997.
Data Analysis

The Statistical Package for the Social Sciences (SPSS) was used to perform statistical analyses for this study. The alpha level was set à priori at 0.05. The following analyses were performed to explore the stated objectives:

1. In order to describe CLS university professors by selected demographics, participants were asked to complete an information technology use instrument (see Appendix D). The following descriptive statistical analyses procedures were applied to the resulting data: age - range, mean and standard deviation; gender - frequencies and percentages; highest level of education - frequencies and percentages; and, major discipline - frequencies and percentages.

2. In order to determine the learning type of CLS university professors through use of the Learning Type Measure inventory, frequencies and percentages were established for dominant type preference as well as the least preferred type.

3. In order to quantify the use of information technology by CLS university professors, participants were asked to rate various types of information technology tools as to the percentage of time they used each type of tool in a regular three to four semester/quarter credit class. A range of percentages was determined in addition to the mean
and standard deviation. A technology score was also calculated and reported with means and standard deviations.

4. In order to ascertain the level of expertise in the use of information technology by CLS university professors, a five-point, forced-choice scale (1 = I don't know enough to respond, 2 = below average, 3 = average, 4 = above average, and 5 = expert) was employed on a self-reporting utilization instrument. Mean scores and standard deviations were calculated.

5. In order to determine if there was a difference in the use of information technology in the classroom by the professors' learning types, a one-way analysis of variance (ANOVA) was utilized. One ANOVA was run with the most preferred learning type quadrant used as the independent variable and the information technology use scores as dependent variables. Another ANOVA was run with the least preferred learning type quadrant used as the independent variable and the information technology use scores as dependent variables.

6. In order to determine if variance of the use of technology in the classroom could be explained by CLS professors' learning type and selected demographic variables (age, gender, level of education, and major discipline) a multiple linear regression was calculated.
CHAPTER 4

ANALYSIS OF DATA

Survey Response

The original number of respondents calculated by Cochran's formula, based on sampling with replacement, was 212. A pre-survey questionnaire was mailed to the sample for the purpose of verifying summer addresses (some clinical laboratory science faculty are on nine-month contracts) and for seeking their willingness to participate. Twelve professors replied that they would not be able to participate, which resulted in a sample size of 200. Following the first mailing of the packet containing the information technology use instrument and the learning types inventory, 129 replies were received (64.5%). After the second mailing to non-respondents (n = 71), 18 returns were received (25.4%). In the mailing phase of the survey, six frame errors were discovered (which lowered the sample size to 194): four people were no longer associated with the university contacted, one professor taught chemistry but not in a clinical laboratory science program, and one professor was from a hospital-based program. The total response rate was 75.8% (147/194) of the professors surveyed. However, two of those responses did not include the information technology tool and were not included in the final sample of respondents (n = 145, 74.7%).
A third follow up was initially conducted using phone dialog, but the Learning Type Measure (LTM) proved difficult to score over the phone. Data from the information technology use instrument was collected by phone while the LTM data was retrieved by facsimile. However, since a random sample was not used for the telephone follow-up, due to difficulties reaching the sample of non-respondents, analyses were performed on data from the respondents to the two mail-outs (n = 145).

Findings by Objective

Research Objective 1

The first research objective was to describe clinical laboratory science university professors by selected demographics, participants were asked to complete an information technology use survey. Descriptive statistics were employed for use in describing the sample population. The mean age for CLS university professors was 48 with a range of 32 - 64 years of age (SD = 6.79). Of the five missing cases, one person wrote in 40-45, one wrote >50, one wrote >21, and two left the question blank. The data for gender, highest level of education, and area of specialty were summarized in Table 1.

The gender distribution was a 1:3 ratio of males to females. In the case of level of education, there were 11 who wrote in unique answers. Of the 11, six could be
Table 1

Demographics of Sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>107</td>
<td>73.8</td>
</tr>
<tr>
<td>Male</td>
<td>37</td>
<td>25.5</td>
</tr>
<tr>
<td>Missing cases</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Highest level of education:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ph.D.</td>
<td>63</td>
<td>43.5</td>
</tr>
<tr>
<td>M.S.</td>
<td>62</td>
<td>42.8</td>
</tr>
<tr>
<td>Specialist</td>
<td>9</td>
<td>6.2</td>
</tr>
<tr>
<td>B.S.</td>
<td>5</td>
<td>3.4</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>3.4</td>
</tr>
<tr>
<td>Missing cases</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Major discipline:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microbiology</td>
<td>39</td>
<td>26.9</td>
</tr>
<tr>
<td>Chemistry</td>
<td>35</td>
<td>24.1</td>
</tr>
<tr>
<td>Hematology</td>
<td>33</td>
<td>22.8</td>
</tr>
<tr>
<td>Immunohematology</td>
<td>24</td>
<td>16.5</td>
</tr>
<tr>
<td>Other</td>
<td>12</td>
<td>8.3</td>
</tr>
<tr>
<td>Missing cases</td>
<td>2</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Note. n = 145

reclassified into existing categories. These included the following degrees: Doctor of Arts in Medical Technology; MPA; MEd; CLSpH(NCA), H(ASCP); and MD. The five counted as other were ABD (all but dissertation) since the highest level could have been either MS or Specialist. In the area of major specialty, there were eight unique answers written in and counted as other (n = 12). These specialty areas included: Management; Immunology; Hematology and
Chemistry; Hematology and Immunohematology; Chemistry and Microbiology; Cell biology and Biomedical technology; Immunohematology, Mycology, and Parasitology; Hematology, Chemistry, Immunohematology, and Microbiology. One unique answer was received as part of the phone follow up. A professor listed her area of specialty as microbiology but then confided that it was originally reproductive biology.

Research Objective 2

The second research objective was to determine the learning type of CLS university professors through use of McCarthy’s Learning Type Measure. The two dominant preferences of learning types among CLS university faculty were Learning Type Two (analytic learners) and Learning Type Three (common-sense learners) noted in Table 2. In the dominant type preference and the least preferred quadrants there were a few tied scores (i.e. when two quadrants had equal scores and a single preferred quadrant could not be determined). Due to the inability to interpret tied scores, data with tied scores were collapsed into a category labeled Other(5) for subsequent analyses. Also, some data (n = 23) were not utilized due to the inability to interpret the dominant and least preferred learning type (i.e., check marks were used instead of weighted scores or lines of data were left blank).
Table 2

Learning Types of Clinical Laboratory Science University Faculty

<table>
<thead>
<tr>
<th>Type/Descriptor</th>
<th>Dominant Type</th>
<th>Least Preferred Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>1 Immacinate</td>
<td>12</td>
<td>8.3</td>
</tr>
<tr>
<td>2 Analytic</td>
<td>41</td>
<td>28.3</td>
</tr>
<tr>
<td>3 Common-sense</td>
<td>51</td>
<td>35.2</td>
</tr>
<tr>
<td>4 Dynamic</td>
<td>10</td>
<td>6.9</td>
</tr>
<tr>
<td>1&amp;2 tied</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>2&amp;3 tied</td>
<td>5</td>
<td>3.4</td>
</tr>
<tr>
<td>3&amp;4 tied</td>
<td>2</td>
<td>1.4</td>
</tr>
<tr>
<td>1&amp;4 tied</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>1&amp;3 tied</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>2&amp;4 tied</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Missing cases</td>
<td>23</td>
<td>15.8</td>
</tr>
</tbody>
</table>

Note. n = 145

Research Objective 3

The third research objective was to quantify the use of information technology in the classroom by clinical laboratory science university professors. The instrument designed to identify use of information technology in the classroom was a self-reporting survey instrument. Participants were asked to fill in the percentage of time, in a regular 3-4 semester/quarter credit class, that they used the selected information technology tools (see Appendix D for instrument). The result was a wide variety of responses ranging from zero to 100%. The mean and
standard deviations of the percentage of time information technology was used in the classroom by CLS university professors was summarized in Table 3.

Table 3
Percent of Time Information Technology Used in the Classroom by Clinical Laboratory Science University Faculty

<table>
<thead>
<tr>
<th>Information technology tools</th>
<th>Mean %</th>
<th>SD</th>
<th>Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>35mm projector</td>
<td>27.62</td>
<td>26.6</td>
<td>2</td>
</tr>
<tr>
<td>Multimedia with graphics</td>
<td>11.60</td>
<td>22.7</td>
<td>25</td>
</tr>
<tr>
<td>Computer with projected image</td>
<td>7.91</td>
<td>18.8</td>
<td>13</td>
</tr>
<tr>
<td>Electronic mail</td>
<td>7.51</td>
<td>17.29</td>
<td>16</td>
</tr>
<tr>
<td>Videocassette recorder</td>
<td>6.78</td>
<td>8.46</td>
<td>4</td>
</tr>
<tr>
<td>Internet</td>
<td>5.36</td>
<td>11.62</td>
<td>17</td>
</tr>
<tr>
<td>Multimedia CD programs</td>
<td>5.02</td>
<td>10.34</td>
<td>25</td>
</tr>
<tr>
<td>Computer with large monitor</td>
<td>4.65</td>
<td>11.61</td>
<td>13</td>
</tr>
<tr>
<td>Compressed video</td>
<td>3.77</td>
<td>14.46</td>
<td>19</td>
</tr>
<tr>
<td>Multimedia databases</td>
<td>3.20</td>
<td>8.88</td>
<td>29</td>
</tr>
<tr>
<td>Laser disc player</td>
<td>2.93</td>
<td>9.08</td>
<td>12</td>
</tr>
<tr>
<td>Multimedia with sound</td>
<td>2.37</td>
<td>8.67</td>
<td>30</td>
</tr>
<tr>
<td>35mm projector + tape</td>
<td>2.02</td>
<td>5.93</td>
<td>12</td>
</tr>
<tr>
<td>Tape player</td>
<td>1.44</td>
<td>3.89</td>
<td>11</td>
</tr>
<tr>
<td>Satellite conferencing</td>
<td>1.34</td>
<td>6.83</td>
<td>18</td>
</tr>
<tr>
<td>CD - music</td>
<td>0.99</td>
<td>6.20</td>
<td>17</td>
</tr>
<tr>
<td>Computer video-conferencing</td>
<td>0.30</td>
<td>1.43</td>
<td>32</td>
</tr>
</tbody>
</table>

Note. n = 145

All missing data were coded as zeros following the assumption that if the individual did not care to list a number then the likelihood was that they did not use the tool at all in the classroom.
The information technology tool used most by CLS professors in the classroom was a 35 mm slide projector. The second most utilized tool was multimedia with graphics. The next two tools most often used in the classroom were computers with a projected image and e-mail. Frequently comments were written in this section of the inventory. Many participants noted that they did not have access to the higher end technologies. Others remarked that they use information technology tools in the student laboratories or for tutorials but not actually in the classroom. There were two participants who mentioned that an important teaching tool was omitted that was used regularly in the classroom: the overhead projector and a multi-headed microscope with video display.

Research Objective 4

The fourth research objective was to ascertain the level of expertise in the use of information technology by clinical laboratory science university professors. Participants were asked to rate their perceived level of expertise on a five-point, forced-choice scale. Faculty rated their level of expertise as being highest with a 35mm slide projector and their lowest with compressed video. Results of responses are summarized in Table 4.
Table 4

Participant Perception of Level of Expertise Utilizing Information Technology

<table>
<thead>
<tr>
<th>Information technology tools</th>
<th>Mean</th>
<th>SD</th>
<th>Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>35mm projector</td>
<td>4.32</td>
<td>0.8</td>
<td>7</td>
</tr>
<tr>
<td>Cassette tape player</td>
<td>4.08</td>
<td>0.9</td>
<td>25</td>
</tr>
<tr>
<td>Videocassette recorder (VCR)</td>
<td>4.07</td>
<td>0.9</td>
<td>9</td>
</tr>
<tr>
<td>35mm projector with tape</td>
<td>3.93</td>
<td>1.1</td>
<td>31</td>
</tr>
<tr>
<td>E-mail</td>
<td>3.67</td>
<td>1.0</td>
<td>27</td>
</tr>
<tr>
<td>Internet</td>
<td>3.35</td>
<td>1.1</td>
<td>25</td>
</tr>
<tr>
<td>Compact disc (music)</td>
<td>3.33</td>
<td>1.3</td>
<td>35</td>
</tr>
<tr>
<td>Computer - large monitor</td>
<td>3.07</td>
<td>1.3</td>
<td>26</td>
</tr>
<tr>
<td>Multimedia-CD</td>
<td>3.00</td>
<td>1.3</td>
<td>37</td>
</tr>
<tr>
<td>Multimedia graphics</td>
<td>2.91</td>
<td>1.3</td>
<td>29</td>
</tr>
<tr>
<td>Computer - projected</td>
<td>2.86</td>
<td>1.3</td>
<td>24</td>
</tr>
<tr>
<td>Laser disc player</td>
<td>2.76</td>
<td>1.4</td>
<td>28</td>
</tr>
<tr>
<td>Multimedia database</td>
<td>2.64</td>
<td>1.3</td>
<td>33</td>
</tr>
<tr>
<td>Multimedia sound</td>
<td>2.38</td>
<td>1.3</td>
<td>37</td>
</tr>
<tr>
<td>Satellite conferencing</td>
<td>2.06</td>
<td>1.0</td>
<td>35</td>
</tr>
<tr>
<td>Multimedia videoconferencing</td>
<td>1.86</td>
<td>1.0</td>
<td>44</td>
</tr>
<tr>
<td>Compressed video</td>
<td>1.84</td>
<td>1.2</td>
<td>34</td>
</tr>
</tbody>
</table>

Note. 1 = I don't know enough to respond, 2 = below average, 3 = average, 4 = above average, and 5 = expert; n = 145

Research Objective 5

The fifth objective was to determine if there was a difference in the use of information technology in the classroom by the professors’ learning types. The original intent was to use the percentage of time the information technology tools were used in the classroom as a dependent variable. However, there were an unexpected number of cells left blank on the instrument (see Table 3). Also, the wide variance in percentages cited for each tool.
brought the validity of that method of scoring into question. Therefore, the data was recoded to reflect use (1) or did not use (0), and an information technology use score was obtained. If the participant scored their use from 1-100 percent of the time, the data was recoded to 1 (use). If the participant chose to leave a cell blank, the data was recoded to 0 (did not use). This collapsed the overall responses into a dichotomous variable. The total technology score was calculated adding the zeros and ones for each of the 17 tools on the instrument for each participant with potential scores ranging from 0-17. To verify the soundness of this decision, a reliability study was performed on the new technology score which yielded an alpha of 0.8264. The results from the recoding were summarized in Table 5.

A one-way analysis of variance (ANOVA) was run with the technology score, as the dependent variable, by the highest preferred learning type quadrant (one through four). Only 121 sets of data were analyzed because some of the data was missing or could not be interpreted into a specific learning type quadrant. There was a significant difference (F = 3.31, p = 0.01) among the learning types and the technology scores (see Table 6). A Tukey's test indicated that the difference was found between learning
Table 5

Technology Scores Reflecting Information Technology Use in the Classroom by Clinical Laboratory Science University Faculty

<table>
<thead>
<tr>
<th>Technology Score</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4</td>
<td>2.8</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>3.4</td>
</tr>
<tr>
<td>2</td>
<td>22</td>
<td>15.2</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>9.0</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>10.3</td>
</tr>
<tr>
<td>5</td>
<td>16</td>
<td>11.0</td>
</tr>
<tr>
<td>6</td>
<td>21</td>
<td>14.5</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
<td>6.2</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>6.9</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>6.9</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>5.5</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>2.8</td>
</tr>
<tr>
<td>12</td>
<td>2</td>
<td>1.4</td>
</tr>
<tr>
<td>13</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>15</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>16</td>
<td>2</td>
<td>1.4</td>
</tr>
<tr>
<td>17</td>
<td>3</td>
<td>2.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>145</td>
<td>100.0</td>
</tr>
</tbody>
</table>

type quadrants 2 (analytic learners) and three (common sense learners).

A one-way ANOVA was also run with the technology score by the least preferred learning type quadrant (one through four). Only 121 sets of data were analyzed because some of the data was missing or could not be interpreted into a specific learning type quadrant. There were no significant
Table 6

**Analysis of Variance in Technology Score by the Highest Preferred Learning Type Quadrant**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>F probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>4</td>
<td>149.08</td>
<td>37.27</td>
<td>3.31</td>
<td>0.0131</td>
</tr>
<tr>
<td>Within groups</td>
<td>117</td>
<td>1316.6</td>
<td>11.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>121</td>
<td>1465.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

differences ($F = 1.30, p = 0.28$) among the learning types based on the technology score (see Table 7).

Table 7

**Analysis of Variance in Technology Score by the Least Preferred Learning Type Quadrant**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F ratio</th>
<th>F probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>4</td>
<td>62.15</td>
<td>15.54</td>
<td>1.30</td>
<td>0.2759</td>
</tr>
<tr>
<td>Within</td>
<td>117</td>
<td>1403.53</td>
<td>12.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>121</td>
<td>1465.68</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Research Objective 6**

The sixth research objective was to determine if variance in the use of technology in the classroom could be explained by CLS professors' learning type and selected demographic variables (age, gender, level of education, and major discipline). A stepwise multiple linear regression was employed with the technology score as the dependent variable.
A significant model (\( p = 0.0006 \)) was derived from the data. Five of the 14 variables were included in the regression equation (see Table 8).

Table 8

Stepwise Regression Analysis of Technology Scores and Selected Variables

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>229.31</td>
<td>5</td>
<td>45.86</td>
<td>4.68</td>
<td>0.0006</td>
</tr>
<tr>
<td>Residual</td>
<td>1087.32</td>
<td>111</td>
<td>9.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1316.63</td>
<td>116</td>
<td>55.66</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Variables in the equation

<table>
<thead>
<tr>
<th>Variable</th>
<th>R²</th>
<th>Cum R²</th>
<th>t</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most preferred quadrant 3</td>
<td>0.08</td>
<td>0.08</td>
<td>4.30</td>
<td>0.0000</td>
</tr>
<tr>
<td>Common-sense</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Least preferred quadrant 3</td>
<td>0.05</td>
<td>0.13</td>
<td>2.93</td>
<td>0.0041</td>
</tr>
<tr>
<td>Age</td>
<td>0.02</td>
<td>0.15</td>
<td>-1.60</td>
<td>0.1118</td>
</tr>
<tr>
<td>Gender</td>
<td>0.01</td>
<td>0.16</td>
<td>1.29</td>
<td>0.2011</td>
</tr>
<tr>
<td>Highest level of education</td>
<td>0.01</td>
<td>0.17</td>
<td>-1.07</td>
<td>0.2883</td>
</tr>
</tbody>
</table>

Variables not in the equation

<table>
<thead>
<tr>
<th>Variable</th>
<th>t</th>
<th>Sign. t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialty</td>
<td>-0.259</td>
<td>0.7962</td>
</tr>
<tr>
<td>High quadrant1 Imaginative</td>
<td>-0.511</td>
<td>0.6103</td>
</tr>
<tr>
<td>High quadrant2 Analytic</td>
<td>-0.423</td>
<td>0.6732</td>
</tr>
<tr>
<td>High quadrant4 Dynamic</td>
<td>0.732</td>
<td>0.4655</td>
</tr>
<tr>
<td>Tied scores (5)</td>
<td>0.509</td>
<td>0.6121</td>
</tr>
<tr>
<td>Low quadrant 1 Imaginative</td>
<td>0.668</td>
<td>0.5053</td>
</tr>
<tr>
<td>Low quadrant 2 Analytic</td>
<td>-0.182</td>
<td>0.8560</td>
</tr>
<tr>
<td>Low quadrant 4 Dynamic</td>
<td>-0.881</td>
<td>0.3804</td>
</tr>
<tr>
<td>Tied scores (5)</td>
<td>0.782</td>
<td>0.4359</td>
</tr>
</tbody>
</table>

Although three of the five variables included in the regression equation had statistically insignificant values,
the researcher chose to include them due to practical significance which was defined as explaining one percent or more of the variance. A total of 17% of the variation in the technology scores were explained by the variables of Learning Type Quadrant 3 (significant if it was the dominant type or the least preferred), age, gender, and highest level of education.
CHAPTER 5
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary of Procedures

This study was designed to explore the status of learning styles of clinical laboratory science (CLS) university-based professors as well as their use of information technology in the classroom. Traditionally clinical laboratory science education has been lecture and lab sessions. However, with the advent of the information age, professors are moving from the role of lecturer to facilitator. Students have the opportunity to be more involved in directing their own learning process through the use of computer-assisted programs, multimedia enrichment, and the Internet. Some professors are in tune with the new information tools and techniques while others are not interested at all. However, to meet the needs of students, it is imperative that the use of information technology be modeled in the classroom.

The research discussed in the previous chapters had a two-fold purpose: 1) to explore who was using technology in the classroom and identify what they were using, and 2) to search for a possible relationship between a professor’s learning style and their use of information technology in the classroom. To meet these ends, the researcher chose to conduct a national survey of university-based clinical
laboratory science professors. A national list of faculty was compiled, and a random sample was chosen. This study employed a commercial learning type tool (McCarthy’s Learning Type Measure) and a self-designed information technology use instrument. A pre-survey questionnaire was conducted to obtain summer addresses for faculty and to encourage participation. A total of 155 (81%) useable responses were received and analyzed.

The Learning Type Measure had three parts: Part A, Part B, and a demographic survey. Part A was the only portion used to determine the highest (preferred) and lowest (least preferred) learning quadrant. Part B related to brain hemisphericity and the demographic portion was required by the research sponsor at Excel, Inc. The information technology use survey had three elements: a place to rate 17 information technology tools as to the percentage of time it was used by the participant in the classroom, a place to rate the participant’s perceived level of expertise with each of the 17 tools, and a brief demographic survey.

Data received from the survey were analyzed using the statistical package SPSS. Descriptive statistics were calculated using demographic variables, learning types, and information technology use scores. Two one-way analysis of variance were performed: 1) the highest preferred learning
type with the technology scores, and 2) the lowest preferred learning type with the technology scores. A significant difference existed between the most preferred learning type quadrants two (analytic learners) and three (common sense learners) based on their technology scores. However, there was no significant difference in the lowest preferred learning type quadrants based on their technology scores. A multiple linear regression was also run with the technology score as the dependent variable and the learning types quadrant and demographics as the independent variables. Seventeen percent of variance in the technology scores was explained by the independent variables which loaded into the regression equation (most preferred quadrant three, least preferred quadrant three, age, gender, and highest level of education).

**Conclusions and Recommendations**

The conclusions drawn from this study were based on data from the responding clinical laboratory science (CLS) university professors. Although the findings cannot be generalized to the population, it is recommended that the study be repeated to determine if these conclusions are representative of the general population of CLS educators.

The first objective was to describe CLS university professors by selected demographics. The typical CLS university professor is an upper middle-aged female with an
advanced degree. This conclusion was based on the following findings. The average age for CLS university faculty was 48 years. The gender distribution was skewed toward females (74%), which was anticipated. This was in agreement with a recent national wage survey of CLS personnel, that indicated the distribution of responses was 23% male, and 76% female (Brzezicki, & Guterl, 1997). The majority of CLS university professors had advanced degrees (92%) and there was a near even distribution among specialty areas. Recommendations for further study would be to analyze the data from the perspective of specialty area to see if there may be a relationship between the professor’s chosen specialty and their use of information technology in the classroom.

The second objective was to determine the learning type of CLS university professors through use of McCarthy’s Learning Type Measure inventory. The average CLS university professor is either an analytic (Type 2) or common-sense learner (Type 3). This conclusion was based on the finding that 28% were analytic learners and 35% were common-sense learners. This outcome was expected by the researcher. Although there was no information in the literature that addressed the learning types or styles of clinical laboratory scientists, a prediction could have
been made for this distribution according to the definition of the learning type quadrants. The mode of information delivery in CLS is primarily through lecture and laboratory sessions, that is, factual knowledge and hands-on skills. These two quadrants represent people who learn by facts and rote memory (Learning Type Two) and by hands-on experience (Learning Type Three). Recommendations for further study would include examining teaching styles in relation to information technology use and exploring the relationship between a professor's learning type and their teaching style.

The third objective was to quantify the use of information technology in the classroom by CLS university professors. The average CLS university professor does use information technology in the classroom. The extent of use varies widely from individual to individual. This conclusion was based on the finding that use of information technology in the classroom ran the gamut from high use of low technology tools (especially the 35 mm slide projector) to consistent use of higher technology tools (especially e-mail and the Internet). Recommendations for further study would include examining the use of information technology in student laboratories and for tutoring or enrichment purposes.
The fourth research objective was to ascertain the level of expertise in the use of information technology by clinical laboratory science university professors. The average CLS university professor perceives some level of expertise with information technology tools. This conclusion is based on the following findings. The majority of professors rated their expertise as above average with the lower end technologies (i.e., cassette tape player and 35 mm slide projector) and a few of the higher end technologies (i.e., e-mail and Internet). A variety of tools were rated with an average level of expertise including compact disc players, multimedia graphics, and computers. Only four out of 17 tools were rated below average on the mean level of expertise. Recommendations for further study include exploring a possible relationship between perceived level of expertise and use of information technology in the classroom. Exploration of ways to improve the information technology use inventory may be pursued to capture more complete data. Clearer, more concise directions could be written for the gathering of data on the use of information technology.

The fifth objective was to determine if there was a difference in the use of information technology in the classroom by the professors’ learning types. The conclusion is that learning types appear to be a factor in
the use of information technology in the classroom. This is based on the finding that the significance level was 0.01 for the ANOVA based on learning types and the information technology scores. Type three learners (common-sense) were significantly different on the information technology score than all the other dominant learning types. Recommendations for further study would include repeating the study to see if the discrimination between learner types is consistent, and improving directions for participants to follow when filling out the Learning Type Measure instrument (which would improve scorable responses).

The sixth research objective was to determine if variance in the use of technology in the classroom could be explained by CLS university professors' learning type and selected demographic variables. The conclusion is that some of the variance in the use of information technology by CLS university professors in the classroom can be explained through the learning type (high or low preference for type 3), age, gender, and highest level of education. This is based on the findings that all five variables explained one percent or more of the variance in the technology scores in the regression model. Recommendations for further study include identifying other variables (such as computer anxiety) that may explain more of the variance.
Strengths and Weaknesses

A weakness of this research was the difficulty in performing the telephone follow up of non-respondents. The follow up was not conducted in a random fashion. Thus, the external validity of the study was compromised. Another weakness was the omission of responses on the information technology use instrument which may indicate the need for a revision of the tool for subsequent studies.

One of the strengths of this research was the national sampling of the target population. Another strength was the number of responses by the Medical Technology community of educators (76% returned versus an expected return of 40 to 60%). Another strength of the research was the finding that, among respondents, there was a significant difference in the use of information technology by the clinical laboratory science professors whose highest preferred learning type quadrant was type two (analytic learners) or type three (common-sense learners).

Summary

Although this study could not be generalized to the population, it appears that clinical laboratory science (CLS) university faculty are using information technology in the classroom. Some are using it more than others but overall there appears to be a trend toward moving into the information age in CLS education. This research provides
new data on learning types among CLS university professors and their use of information technology in the classroom.
REFERENCES


matter of accommodation? Journal of Nursing Education. 32, 64-70.


APPENDIX A
REQUEST FOR FACULTY INFORMATION

Date: Sun, 16 Feb 1997 19:28:28 -0600 (CST)
From: Cynthia S Handley <chandl1@tiger.lsu.edu>
Subject: [1628] CLS University Faculty List
Resent-From: clseduc-l-error@APSU01.APSU.EDU

First I would like to say thank you to those who responded to my question concerning the addresses of CLS programs. I did order the list from NAACLS (you can, BTW order a plain paper copy, rather than labels at a somewhat discounted price). However, I could still use some help. My study will be surveying university-based CLS faculty and to date, I only have a list of programs, not individuals. Since my sample needs to be individual faculty members, I would like to ask for program directors of university-based programs to fax or e-mail me a list of their faculty members specifying the discipline they teach. (I hate to sound so cheap but this way will save me A LOT of expenses in photocopying and postage). Then I will follow up the other programs (people not on the BBS or not able to respond) with a letter to ask for further assistance. In return, I will make the list available to anyone who asks for a copy. There are 140 university-based programs so the list will be fairly long but I think it would be a great asset to other researchers. Thanks in advance for your replies, I really appreciate your assistance.

Cindy Handley
(504) 388-5755 FAX
CHANDL1@tiger.lsu.edu
May 2, 1997

FIELD(Title)
FIELD(Address)
FIELD(Address2)
FIELD(Address3)
FIELD(City, State Zip)

Dear FIELD(Name):

You have been selected out of 502 university-based clinical laboratory educators to participate in a national study concerning learning styles/types and the use of information technology in the classroom. Your assistance is needed for the success of this research.

You, as an educator, are a very important key to this study. Results of this study may help us explain why some educators embrace new information technologies while others shun it. Your input will also be integral in designing workshops to help clinical laboratory science educators make the most of today’s explosion of information technology opportunities. Would you be willing to complete a learning style tool and an information technology survey? This should only take about 15-20 minutes of your time but the benefits are innumerable.

You will find enclosed a post card (with postage) asking for your decision concerning participation. Since the study will take place early in the summer, we are also asking for a summer address, phone number and e-mail address. Your anonymity will be maintained throughout the research process and all results will be published as summary information. Please provide me with your decision ASAP by marking and returning the self-addressed, postage-paid postcard enclosed (this should require less than 5 minutes of your time).

We look forward to hearing from you soon. Thanks in advance for your participation in this important research.

Sincerely,

Cindy Handley
Betty C. Harrison

Cindy Handley, MS, MT(ASCP)
(504) 388-5748

Betty C. Harrison, PhD
(504) 388-5748
Please place an (x) in the appropriate space provided below.

_____ I will participate in the study on learning styles and the use of information technology.

My summer address is:

Phone #: ___________________________
E-mail: ___________________________

_____ I will not be able to participate in the summer study.

Cindy Handley
142 Old Forestry Building
Louisiana State University
Baton Rouge, LA 70803
COMPONENTS OF THE LEARNING TYPE MEASURE (LTM)

Part A:
15 Statements to complete.

Stems such as:
I excel at. . .
Learning environments should emphasize. . .

Choices such as:
making realistic decisions
connections to personal meaning

Part B:
Watching & Doing score

(Not used in this research)

Due to copyright issues, The Learning Type Measure® instrument could not be published. However, information for ordering the tool can be obtained from the following source:

Excel, Inc.
23385 Old Barrington Rd.
Barrington, IL 60010

(800) 822-4MAT
(847) 382-7272
June 7, 1997

Clif St. Germain, Ph.D.
Director of Research, Excel Corp.
1011 N. Causeway Blvd.
Brookside Office Park, Suite 16
Mandeville, LA 70448

Dear Dr. St. Germain,

I have enclosed the proposal for my dissertation entitled, University-based Clinical Laboratory Science Faculty Learning Styles and Their Use of Information Technology in the Classroom. I would like to ask for permission to use the Learning Type Measure published through Excel for research purposes. I would also like to ask for permission to quote excerpts from the LTM Presenter's Manual, particularly regarding reliability and validity.

I plan for this study to be foundational for future research on learning styles and the 4MAT system. Thank you for your commitment to research and to excellence in teaching and learning.

Sincerely,

Cynthia S. Handley, MS, MT(ASCP)
Ph.D. candidate
142 Old Forestry Building
Louisiana State University
Baton Rouge, LA 70803

(504) 388-5748 [work]
(504) 344-7419 [home]
June 18, 1997

Ms. Cynthia S. Handley, MS, MT
Ph.D. Candidate
142 Old Forestry Building
Louisiana State University
Baton Rouge, LA 70803

Dear Cindy,

The enclosed material is per your conversation with Susan Rossie today.

Should you have any questions, please don't hesitate to call.

Thank you.

Sincerely,

[Signature]

Susan Sibley
Administrative Assistant

cc: S. Rossie

Enclosures
INFORMATION TECHNOLOGY USE INSTRUMENT

University-based Clinical Laboratory Science Faculty’s Use of Information Technology in the Classroom

Please return survey to:
Cynthia S. Handley
Louisiana State University
School of Vocational Education
142 Old Forestry Building
Baton Rouge, LA 70803
INFORMATION TECHNOLOGY USE SURVEY

Please rate the following types of information technology tools in two categories:

A. What percentage of the time, in a regular 3 to 4 semester/quarter credit class, do you use the following information technology tools in the classroom?

B. Please rate your level of expertise using each type of tool:
   1 = I don't know enough to respond  2 = below average  3 = average  4 = above average  5 = expert.

<table>
<thead>
<tr>
<th>INFORMATION TECHNOLOGY USE IN THE CLASSROOM</th>
<th>A. Percentage of time used in typical 3 to 4 credit semester/quarter course</th>
<th>B. Level of Expertise 1,2,3,4,5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio cassette player</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35-mm slide projector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35-mm slide projector with tape player</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCR player</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laserdisc player</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD player (sound only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite conferencing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressed video</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer with large monitor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer with projected image</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multimedia: Instructional CDs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD databases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphics in presentations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sound in presentations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer videoconferencing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-mail</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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SELECTED DEMOGRAPHICS

Please enter the appropriate data for each of the items below:

Age: _____

Gender: _____ male _____ female

Highest level of education:

_____ B.S. _____ M.S.

_____ Specialist _____ Ph.D. or Ed.D.

_____ other (please specify ____________________)

Area of specialty: _____ Hematology

(one answer only) _____ Chemistry

_____ Immunohematology

_____ Microbiology
Definition of Terms

**CD-ROM:** “A compact disc with read-only memory (ROM). CD-ROMs provide a lot of storage capacity, which is required by programs with memory intensive features like digitized sound, graphics, and video” (Kanning, 1994, p. 45).

**CD database:** Resource databases maintained on CD-ROM. Examples include the following: ERIC, CINAHL and MedLine.

**Compressed video:** When video is sent over fiber optic cables to remote sites. Participants at each site are able to view other participants and communicate via desktop speakers. This is often used in distance learning classrooms.

**Computer videoconferencing:** When digital video cameras are utilized to link people at two, or more, distant sites through computer interfaces.

**Electronic mail (e-mail):** A form of electronic messaging that allows users to send and receive text, graphics, sounds, etc., through the use of phone lines or direct connection (IE network servers).

**Information technology:** “Technology dealing with information processing, storage, and transmission. This includes in particular computer technology and different communication technologies...” (Hornung, 1997, p. 1).

**Internet:** A worldwide computer network connecting individuals, organizations, and other computer networks to information services and electronic mail.

**Laserdisc:** “A disc on which video information is stored; it is read with a laser beam in a manner analogous to a phonograph needle picking up sound from a record” (Kanning, 1994, p. 45).

**Multimedia:** “The term multimedia means that more than one medium of communication is employed to deliver a message. Multimedia presentations may combine video, sound, graphics, still photography, animation, and text” (Kanning, 1994, p. 40).

**Satellite conferencing:** The use of satellite connections to view distance learning conferences. Often the participants are also linked via phone lines to interact with people at other distant sites involved in the same conference.
LETTER FROM FIRST MAILING

June 23, 1997

Dear FIELD(Name):

You have been selected out of 502 university-based clinical laboratory science educators to participate in a national study concerning learning styles/types and the use of information technology in the classroom. Your assistance is needed for the success of this research.

You, as an educator, are a very important key to this study. Results of this study may help us explain why some educators embrace new information technologies while others shun it. Your input will also be integral in designing workshops to help clinical laboratory science educators make the most of today's explosion of information technology opportunities. The survey should only take about 15-20 minutes of your time but the benefits will be innumerable.

You will find enclosed a learning type inventory (LTM), an information technology use survey, and a self-addressed, stamped envelope (SASE). Please fill out the LTM (front and back) and the survey, then fold each to fit the SASE provided and return ASAP. Your anonymity will be maintained throughout the research process and all results will be published as summary information.

We need your response by July 9, however, it will only take a short time to fill out so please take a moment and do it today. We look forward to hearing from you soon. Thanks in advance for your participation in this important research.

Sincerely,

Cindy Handley
Cindy Handley, MS, MT(ASCP)
CHANDL1@tiger.lsu.edu
(504) 388-5748

Betty C. Harrison
Betty C. Harrison, PhD
Professor
(504) 388-5748
REMINDER LETTER

July 17, 1997

Dear Colleague:

Recently you should have received a letter asking for assistance with an information technology survey and learning styles inventory. To date, we have not received your response. We understand that the summer is a busy time, however, we value your input and ask that you take just a few minutes to relocate the packet, fill it out, and return it to us. So far we have had an excellent return, but we want to hear from YOU. Thank you for your time on this project.

Cindy Handley  Betty C. Harrison
Cindy Handley
Louisiana State University  Professor
LETTER FROM SECOND MAILING

August 18, 1997

Dear [Name],

You have been selected out of 502 university-based clinical laboratory science educators to participate in a national study concerning learning styles/types and the use of information technology in the classroom. However, I have not heard from YOU and your assistance is needed for the success of this research.

You, as an educator, are a very important key to this study. I know, however, that you are busy with school starting soon but I encourage you to take just 15-20 minutes of your time as soon as possible to provide your valuable input.

You will find enclosed a learning type inventory (LTM), an information technology use survey, and a self-addressed, stamped envelope (SASE). Please fill out the LTM (front and back) and the survey, then fold each to fit the SASE provided and return ASAP.

Your anonymity will be maintained throughout the research process and all results will be published as summary information.

We need your response by [August 29], however, it will only take a short time to fill out so please take a moment and do it today. We look forward to hearing from you soon.

Thanks in advance for your participation in this important research.

Sincerely,

Cindy Handley

Cindy Handley, MS, MT(ASCP)
chandley@prodigy.net
(504) 343-5433

Betty C. Harrison

Betty C. Harrison, PhD
Professor
(504) 388-5748
VITA

Cynthia S. Handley was born in El Dorado, Arkansas. She is the oldest daughter of Earl and Delberta Handley. Ms. Handley graduated from El Dorado High School in 1977. She received her baccalaureate degree in Medical Technology from the University of Arkansas for Medical Sciences in 1981, and her master’s degree from the University of Southern Mississippi in 1993. Ms. Handley has fifteen years of experience in Medical Technology with the last nine years spent in Clinical Laboratory Science education. She has published articles in several journals and has presented at state and national meetings of the American Society for Clinical Laboratory Scientists. She will receive her doctor of philosophy degree from Louisiana State University in May of 1998.

Ms. Handley is currently working for United Blood Services as a reference medical technologist. She is also the Safety Officer for the Louisiana UBS centers and assists with coordinating continuing education in Clinical Laboratory Science. Her goals include: pursuing a career in higher education either in Medical Technology or Health Occupations Education; volunteering in church and civic groups; and returning to her first love - music.
DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Cynthia S. Handley

Major Field: Vocational Education

Title of Dissertation: Clinical Laboratory Science University Faculty Learning Types and The Use of Information Technology in the Classroom

Approved:

[Signature]
Major Professor and Chairman

[Signature]
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

December 15, 1997