AN ASSESSMENT OF TECHNOLOGY LEARNING STYLES, SKILLS, AND PERCEPTIONS
AMONG TEACHERS OF GRADES PRE-KINDERGARTEN THROUGH FOUR

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Brubaker, Douglas D., An assessment of technology learning styles, skills, and perceptions among teachers of grades pre-kindergarten through four. Doctor of Philosophy (Educational Computing), December 2004, 110 pp., 15 tables, 6 illustrations, references, 77 titles.

This study investigated whether a relationship exists between learning style and the self-reported technology-related needs, beliefs, stages of adoption, software expertise, and technology competencies of teachers in a large suburban school district. The Gregorc Style Delineator was used to identify dominant learning style, and the Snapshot Survey was used to measure technology-related needs, beliefs, stages of adoption, and software expertise. Technology competencies were measured using the Technology in Education Competency Survey. Data collected from 499 participants was included in data analysis. The study was conducted at each of the 12 elementary schools of a large suburban district in the Dallas-Fort Worth Metroplex.

The findings suggest that there is a significant relationship between learning style and the technology-related needs, stages of adoption, software expertise, and competencies of teachers. The relationship between learning style and technology-related needs was significant at the p < .01 level. The relationships between learning style and technology-related stages of adoption, software expertise, and technology competencies were significant at the p < .05 level. Members of the abstract sequential [AS] learning style group reported having significantly fewer needs and significantly higher stages of adoption, software expertise, and competency than members of one or more of the other learning style groups.

More research is recommended to determine whether these findings could be utilized to improve teacher staff development in the area of technology. Possible applications may include mentoring programs and the customization of training models to more closely match learning style profiles.
ACKNOWLEDGEMENTS

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CHAPTER 1

INTRODUCTION

Since the beginning of the Industrial Revolution, successive waves of new and domestically developed technologies have fueled economic growth in the United States. When foreign competition has eroded American predominance in a given field, the dramatic growth of another sector has provided jobs to replace a share of those that have been lost.

The last thirty years of the twentieth century, when many multinational corporations exported factories and jobs to the developing world, provide a key example of this phenomenon. Innovations in computer hardware and software production led to the development of new industries in which a comparatively highly trained and expensive workforce was an asset. Innovators such as Steve Jobs and Bill Gates have played critical roles in the creation of jobs that have employed millions of American workers.

As the first five years of the new millennium draw to a close, foreign competition again threatens to siphon jobs away from the United States. According to the American Electronics Association (AEA), “High-tech employment totaled 6 million in 2002, down from 6.5 million in 2001” (p. 1). This may be because a dramatic decrease in the cost of telecommunications and the growth in the number of qualified overseas workers have made it possible for American businesses to develop software and provide technology related support services from foreign countries more inexpensively (Information...
Technology Association of America (ITAA) 2003). The ITAA’s 2003 survey of 374,129 companies also found that 12% of companies engaged in IT commerce outsourced jobs overseas. The types of jobs most likely to be sent overseas require more skill and command higher wages than one might expect:

While offshore development is often considered an alternative for low end “commodity” work, the ITAA survey finds programming/software engineering the job category most likely to go overseas (67%), followed by network design (37 %) and Web development (30%). In terms of jobs going overseas in the next six months, companies cited programming/software development (35%) and technical support (29%). (ITAA, 2003, p. 12)

This state of affairs may leave one asking about the source of America’s next great economic engine. Perhaps because the next generation of innovators and entrepreneurs is currently enrolled in K-12 schools across the country, concern has grown about the need to prepare these students for the competitive environment that they will face. This, in turn, has spurred efforts to provide technology tools and training for America’s children. The National Center for Educational Statistics (NCES) estimates that American schools spend over $5 billion on educational technology (2003).

In some respects, these efforts have been successful. Computers and Internet access are much more widely available in schools. Since 1983, the total number of computers in U.S. classrooms is estimated to have grown from less than 50,000 to more than 5.8 million (Mehlinger, 1995; U.S. Congress, Office of Technology
Assessment, 1995). Between 1998 and 2000, the percentage of U.S. classrooms connected to the Internet rose from 27% to 63% (Revenaugh, 2000). Between 1996 and 2000, over 1,000,000 classrooms were wired to the Internet (Carvin, 2000; U.S. Congress, Office of Technology Assessment, 1995 as cited in Rovai and Childress, 2002). The growth in federal spending on technology from $21 million in 1995 to $729 million in 2001 has also helped to accelerate access to computers in schools (Russell et al., 2003). Each of these conditions suggests that more hardware may be available for classroom use.

Yet research suggests that student use of computers has not increased. A 1997 study of teachers and administrators sponsored by Jostens Learning Corporation found that teachers were more likely to be creating documents, spreadsheets, or graphics for “personal productivity” than using it instructionally (1997, as cited in Earle, 2002). In a recent telephone survey, 39% of middle and high school students said that they “hardly ever” use computers in school (Public Agenda, 2001). The Snapshot Survey, conducted with 3,665 teachers in four states, found that 14% of K-12 teachers do not use technology for instruction, and 45% use it for instructional purposes fewer than 15 minutes per week (Norris et al., 2003).

If there are more computers in classrooms and Internet access is more widely available, why are students not using computers for educational purposes at a higher rate? If time is not being allocated for the use of instructional technology, it is advisable to investigate relationships between the skills and beliefs of the people in public schools
who are responsible for scheduling the majority of the school day. In self-contained and semi-departmentalized elementary settings, teachers perform this function. As a result, it is possible that the use of educational technology in K-12 environments may be limited by the degree to which classroom teachers embrace it. Teachers may not only avoid using technology for instructional purposes themselves, but also fail to provide opportunities for their students to do so.

The Problem

Do the learning styles of teachers have a relationship with the degree of comfort and proficiency with which they work with educational technology? Specifically, do the learning styles of teachers relate to the technology-related needs, beliefs, levels of adoption, software expertise, and competence related to educational technology?

Purpose of the Study

The purpose of the study was to determine whether teachers with the same dominant learning style shared similar characteristics with respect to their beliefs about, and proficiency with, educational technology.

Research Questions

This study was designed to explore the research questions listed below:

1. What is the difference between the dominant learning styles of teachers and their responses to survey questions about their technology related needs?
2. What is the difference between the dominant learning styles of teachers and their responses to survey questions related to their beliefs about technology?
3. What is the difference between the dominant learning styles of teachers and the stage of adoption with which they identify?

4. What is the difference between the dominant learning styles of teachers and their scores on a software expertise survey?

5. What is the difference between the dominant learning styles of teachers and their scores on a survey related to their competence regarding the use of technology in educational settings?

Significance of the Study

Given the massive amounts of funds being spent annually on instructional technology in public schools, the threat posed by increased foreign competition for technology jobs, and anticipated budget cuts in education due to slow job growth and diminished tax revenue, it is important to study ways in which staff development dollars may make a more significant and positive impact on the technology related attributes of teachers (Hermann, 2003).

Determining whether learning styles impact teacher technology attributes may lead to more efficient delivery models for technology staff development. There is a significant body of research that suggests that the amount of computer training that teachers have had can impact both their own level of use and the degree to which they structure their classes to allow student use (Baylor & Ritchie, 2002; Dursick, 1998; Earle, 2002; Knezek, Christensen, Hancock & Soho, 2002). Orr, Allen and Poindexter state, “Institutions of higher education as well as organizations must provide relevant,
structured computer instruction for students and employees” (2001). Stanley also notes that properly structured staff development can help to erode teacher resistance:

... despite the initial and sometimes deeply entrenched resistances they had to computers, the majority of new computer users quickly overcame their fears and reservations once they had an actual hands-on computer encounter in a supportive and comfortable learning environment. (2003, p. 413-414)

Stanley’s statement suggests that offering classes, however, is not enough. It is also important to structure them in ways that are supportive and comfortable to the learner. Research into a possible relationship between technology-related characteristics and learning styles may help to implement strategies that render technology staff development sessions more supportive and comfortable to teachers. Reconfiguring training classes may have a significant, positive, and long-term impact.

Teachers with more professional development in the use of computers and the Internet over the last 3 years were more likely to assign students various types of work involving computers or the Internet. For example, teachers with more than 32 hours of professional development were more likely to assign problem solving (41%) than were teachers with 0 hours (14%) or those with 1 to 8 hours (24%), graphical presentations (31 compared with 10% and 16% for the same groups), and demonstrations or simulations (29 compared with 8% and 13% for the same groups). (NCES, 2000)
Research activity in the area of learning styles within the field of education has led to inquiry regarding the matching of learning styles with instructional practices that are designed to best accommodate them. Dunn & Dunn (1979) noted that matching learning style with mode of instruction can increase the instructional effectiveness of learning environments.

Research suggests that people learn optimally when they receive information through specific modalities. If this is true, it is incumbent upon teachers to make certain that they use a variety of instructional strategies, materials, and activities in each lesson so that course content is presented in the way that each student in the class learns best (Sternberg & Grigorenko, 1997). As George, Sleeth, and Pearce advise, “We should reach out to specific groups . . . to channel their efforts towards greater use of technology in classrooms” (1996, p. 604).

As the review of relevant literature will illustrate, there are no studies that have been conducted with elementary teachers exclusively. Given the distinct nature of elementary and secondary assignments, it is reasonable to believe that there would be differences in the combinations of learning styles, needs, beliefs, stages of adoptions, software expertise, and competence in teachers at these different levels of instruction.

The literature review will also show that there is a lack of research comparing learning styles with factors related to teacher technology use as defined in this proposal.
Basic Assumptions

It was assumed that teachers responded honestly to survey items about their technology needs, beliefs about technology, levels of adoption of technology, software expertise, and competency using technology.

Limitations of the Study

The study was conducted with teachers of grades pre-kindergarten through four in Mansfield Independent School District in Tarrant County, Texas. The results of this study may not be applicable to teachers of other grade levels.

Mansfield ISD is a suburban school district with 570 elementary school teachers and the second-fastest growth rate among school districts in Texas with populations of over 10,000 students. The results of this study may not be applicable to districts that do not have similar characteristics.

Definition of Terms

*Cognitive styles/learning styles:* Cognitive styles are defined as “people’s characteristic and typically preferred modes of processing information” (Sternberg & Grigorenko, 1997, p. 700). Bishop-Clark (1995, citing Messick, 1984) states that cognitive styles are “consistent individual differences in organizing information, and processing both information and experience (and) generalized habits of thought” (p. 242). Both definitions mean essentially the same thing: people are more likely to process information in ways that are comfortable to them, and these preferences are based in part on their individual personalities (Sternberg & Grigorenko, 2000).
Goldstein and Blackman add another dimension to the definition by noting that cognitive styles “mediate between environmental input and the organism’s output” (1978, p. 3 citing Zajonc, 1968). This means that between the time that stimuli are received through the sensory organs and the moment that the individual responds to them, cognitive styles guide the individual in choosing that response.

**Educational technology:** For the purposes of this study, this term refers to electronic components and software that are used to facilitate learning in an educational setting.

**Learning style:** This is a more specific term used to describe how the stimuli related to learning knowledge and skills are processed through the senses and incorporated into existing knowledge. Learning style also relates to how individuals organize and control learning strategies, which are ways of completing a given task (Huai, 1997 citing Messick, 1987). The distinction between learning and cognitive styles is that cognitive styles are methods of organizing and controlling all cognitive processes, while learning styles relate to the ways in which the cognitive task of learning is accomplished.

**Mind style:** This is a model of cognitive or learning style, which was created by Anthony Gregorc and is described in the literature review.

**Teacher, elementary:** This is a certified teacher of grades pre-kindergarten through four, including specialized classes such as special education, remediation, art, music, foreign language, and physical education.
Organization of the Study

Chapter 1 provides an introduction to the study and defines the research
questions and related terms. Chapter 2 includes a review of research that is relevant to
the study. Chapter 3 describes the methodology used to collect data and present the
results. Chapter 4 will include an analysis and presentation of the data. Chapter 5 will
include a summarization of the study as well as conclusions, implications, and
recommendations for additional research.
CHAPTER 2

REVIEW OF RELATED LITERATURE

Introduction

The study of learning styles, their interaction with technology use patterns, and their impact on a variety of other technology-related characteristics has generated a considerable volume of research. This chapter provides an overview of research that identifies teacher characteristics as a factor for technology use in schools. It also explores the history of cognitive and learning styles as an area of research within the field of educational psychology. An explanation of organizing principles for cognitive and learning styles follows. A description of the more significant learning style models – including the tests used to assess them -- is presented, followed by a more detailed explanation of Gregorc’s mind styles, the cognitive style model used as the theoretical basis of this study. The findings of prior investigations using the Gregorc model that are related to teachers’ technology-related needs, beliefs, feelings of competence, software expertise, and levels of adoption are summarized, followed by findings of studies that have been undertaken to investigate the impact of matching learning styles with theoretically compatible learning environments. The chapter concludes with a brief overview of studies that have previously used the survey instruments selected for this investigation.
Factors Related to Classroom Technology Use

A significant body of research explores factors that determine whether technology is used in the classroom for instruction. Many of them identify the personal characteristics of teachers as a possible obstacle to overcome in the effort to use computers for instructional purposes (Christensen, 2002; Milbrath & Kenzie, 2000; Ropp, 1999).

In a quantitative study of 94 classrooms, Baylor and Ritchie (2002) investigated the impact of the “planning, leadership, curriculum alignment, professional development, technology use, teacher openness to change, and teacher non-school computer use” on student learning and teacher skill and morale (p. 395). Stepwise regression was used to determine which combinations of variables affected one another. The study found that openness to change and use of technology with others among teachers impacted the degree to which those teachers used technology in the classroom for instructional purposes. The authors noted, “Regardless of the amount of technology or its sophistication, technology will not be used unless faculty members have the skills, knowledge, and beliefs necessary to infuse it into the curriculum” (Baylor & Ritchie, 2002, p. 398).

Earle (2002) reviewed literature from the field of educational technology in order to identify factors that restrain teachers from using technology in instructional settings. Citing the work of other researchers, he identified access, time, training, cultural
acceptance, leadership, and technical support as factors that needed to be present to successfully integrate technology into instruction.

Knezek et al. (2000) used structural equations to formulate and investigate the validity of the will-skill-tool model. They found that teachers who have the will to use instructional technology, the necessary technology skills, and access to the appropriate hardware and software tools are more likely to use technology in the classroom than teachers who lack those attributes.

Becker’s analysis of the Teaching, Learning, and Computing Survey -- a study of over 4,000 teachers of grades four through twelve in over 1,000 American schools -- indicated that teachers rated in the top 25% with regard to computer skills, variety of use of computers, and experience working with computers “had students use three times the number of types of software than teachers in the bottom 25%” (2000, p.12).

In research related to other topics, scholars have cited similar concerns about teacher characteristics and their impact on learning. Dursick (1998) adds that “personal social cognitive factors” such as attitude, anxiety, self-efficacy, willingness to make time commitment, (willingness to) face risks, competency, beliefs, perceptions of relevance, and lack of knowledge” have an impact on technology use in the classroom. In Fulton’s (2001) review of the U.S. Congress Web-Based Commission report on improving learning on the Web, she noted that between 33% and 66% of teachers do not use available computers for instruction because they do not feel comfortable using them for
that purpose (2001). George and Camarata (1996) attribute the reluctance of teachers to use technology to a lack of confidence in their abilities to do so.

While teacher characteristics have been widely identified as factors that impact technology use in schools, the significance of such factors is not universally accepted. While Cuban (2000; 2001) argues that students have more access than ever to classroom technology, Norris, Sullivan, Poirot, and Soloway (2003) conducted a study investigating a possible link between technology access and classroom technology use using Snapshot Survey data from 3,665 teachers in California, Florida, Nebraska, and New York. Norris et al. (2003) found that technology use was almost exclusively a function of access, to the exclusion of the individual differences of teachers. Conlon and Simpson (2003) have also found that individual differences among teachers with respect to computers appears to be fading as more computers are found, and frequently used, in teachers’ homes in Scotland.

As a result of this ongoing dispute, the role of technology-related characteristics among teachers and their impact on technology use in schools remains a viable area for further research. In fact, research on beliefs and personality characteristics is arguably a more pressing need than other factors such as access and staff development. This is because the personal characteristics of teachers may be more challenging obstacles to address. Instituting additional staff development programs and purchasing more equipment may remedy skill deficits and increase the number of computers available for teachers and students to access. To create high quality staff development programs
that promote the use of instructional technology, personal attributes of teachers need to be identified and addressed. Teachers who are forced to independently experiment with new equipment or participate in workshops that do not meet their needs may develop more resistance to technology. People who have experienced frustration in learning to use technology are likely to be more resistant to it or have anxious feelings about it, depending on the reasons that they believe they have failed (George & Camarata, 1996; Martinko, Henry, and Zmud, 1996; Morgan, Morgan, & Hall, 2000). These findings suggest that if an individual participates in training in a manner that does not result in success, initial resistance to technology may be further entrenched.

Cognitive Styles Research: A Historical Perspective

Research in the area of cognitive styles is focused on identifying factors that distinguish the thought processes of one person from those of another. It also helps to explain why individuals think and act in different ways when presented with the same types of sensory stimuli. Work in this area began in the late 1800s when psychologists attempted to identify a link between low-level, observable cognitive processes such as sensory acuity, finger tapping, and speed reacting to stimuli (Dillon and Watson, 1996).

Early efforts in cognitive styles research sought to explain the role of personality in determining how people think and act. Karl Jung was one of the earliest researchers to explore this field. He believed that people learned in different ways, in part because of their unique personalities. Jung’s model of personality types laid the foundation for
the Myers-Briggs Type Inventory ® (MBTI) instrument (CCP, Inc., Palo Alto, CA, www.cpp.com) that is used today (1923, cited by Sternberg and Grigorenko, 1997).

There is an immense amount of material that has been published over the past sixty years related to the concept of cognitive styles. In Messick’s model alone, he identified nine different styles, including scanning, leveling-sharpening, constricted-flexible control, tolerance for incongruous or unrealistic experience, field-dependence, cognitive complexity, reflection-impulsivity, styles of categorization, and styles of conceptualization (Messick 1970, cited in Goldstein and Blackman, 1978). By 1976, his list had grown to 19. Other researchers have been completing similar work in comparable volume. It is challenging to produce a comprehensive overview of the literature, because a complete, coherent, and widely accepted framework does not already exist for categorizing the multitude of constructs into a single system. Sternberg notes that this has created problems for researchers in the field:

. . . the styles literature has failed to provide any common conceptual framework language for researchers to communicate either with each other to with psychologists at large . . . The result is a kind of balkanization of research groups, and balkanization always has led to division and, arguably, deaths of a thousand cuts (2000, p. 250).

The intensity of interest and research activity in the area also appears to rise and fall on a cyclical basis. In 1978, Goldstein and Blackman note that interest is building in the area of cognitive styles research and cite it as a reason for writing their book. Almost 20
years later, Sternberg and Grigorenko speculate that another active era in cognitive styles research may be at hand and muse that cognitive styles, “much like wide neckties,” seem to go in and out of fashion on a cyclical basis (1997, p. 701). This further complicates the task of encapsulating all of the relevant research into one review.

Cognitive Styles Research: Organizing Principles

Sternberg and Grigorenko (1997) have developed a list of common characteristics that they assert are shared by all valid models of cognitive style. These include theoretical specification, internal validity, convergent external validity, discriminant external validity, and heuristic generativity. Theoretical specification refers to the completeness, internal consistency of the model, and its basis in existing psychological theory. Internal validity is the extent to which internal analysis is able to demonstrate that the results of data collected are predicted by theory. Convergent and discriminant external validity exist when the data collected using a style measure correlate to other measures to which, in theory, they should relate and yet do not correlate to other measures to which, it theory, they should not. Heuristic generativity is the degree to which a theory has generated additional research and application (Sternberg & Grigorenko, 1997).
Table 1

*Characteristics of Valid Cognitive Styles Models*

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<td>Theoretical Specification</td>
<td>The positing of a reasonably complete, well-specified, and internally consistent theory of style that makes connection with extant psychological theory.</td>
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<td>Internal Validity</td>
<td>A demonstration by factor analysis or some other method of internal analysis that the underlying structure of the item or subtest data is predicted by theory.</td>
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<tr>
<td>Convergent external validity</td>
<td>A demonstration that the measures of styles correlate with other measures with which, in theory, they should correlate.</td>
</tr>
<tr>
<td>Discriminant external validity</td>
<td>A demonstration that the measures of styles do not correlate with other measures with which, in theory, they should not correlate.</td>
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<tr>
<td>Heuristic generativity</td>
<td>The extent to which the theory has spawned and continues to spawn psychological research and, ideally, practical application.</td>
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</table>

(Sternberg and Grigorenko, 1997)

Sternberg and Grigorenko also distinguish between Cognition-Centered, Personality-Centered, and Activity-Centered approaches to cognitive style research (1997). For the purposes of this discussion, Sternberg and Grigorenko’s taxonomy will be utilized to organize information gleaned about the various schools of cognitive and learning styles research (1997). This approach has been selected because it provides a framework for reviewing a diverse field of study, and it has been repeatedly cited in the literature (Cano-Garcia & Hughes, 2000; Rayner & Riding, 1997; Zhang, 2002a; Zhang, 2002b).
Salient models not addressed in the Sternberg and Grigorenko article will be integrated into the framework in order to assure that the approaches most applicable to educational technology remain the focus of this review.

**Cognitive-Centered Approaches**

The field-dependence/field-independence model is an example of a cognitive-centered approach to cognitive styles research. The disciplinary roots of this model may be found in the field of psychology. Hayes and Allinson describe the field-dependence/independence model as “the most thoroughly research dimension of cognitive style” (1996, p. 67). Study in this area began as the researchers began to explore how subjects were able to determine their physical orientation to the ground without any visual cues (Witkin, Moore, Goodenough & Cox, 1977). Witkin and his colleagues discovered that some people rely on perceptions of the area around them, or the prevailing field, for cues about the structure of their environment. This mode of perception is known as field-dependence. The mode of perception that enables one to perceive without cues from the surrounding environment is known as field-independence.

The tests most commonly associated with this model are the Rod and Frame Test (RFT), the Body Adjustment Test (BAT), and the Embedded Figures Test (EFT). Subjects begin the RFT by sitting down in a chair in a darkened room and looking at a luminous visual frame. The frame is constructed so that it will rotate in either clockwise or counterclockwise direction. A luminous rod is fastened to the frame at the center and
is also capable of turning clockwise or counterclockwise. Subjects are asked to turn the rod until it is in what the subject perceives to be an upright position (Witkin et al., 1977). Witkin discovered a wide range of abilities in completing this task. Some subjects would determine that the rod must be aligned with the surrounding frame in order for it to be upright, regardless of the position of the frame. At the other end of the performance spectrum are those who are able to move the rod so that it is upright regardless of the position of the surrounding frame. Gravity provides one clue for the subject, but the absence of light eliminates the presence of visual lines, such as walls, which would normally serve as a guide. The researcher then calculates the score by determining the degree to which the rod is turned upright.

The second test that is commonly used to determine field-dependence or independence is the BAT (Witkin et al., 1977). The subject is placed in a darkened room in a chair. The chair is then tilted to a specified degree, and the subject is asked to turn the chair to the position that he or she perceives as being upright. Similar results are reported for this test as for the RFT. This is because both tasks involve determining one’s position in space without any visual cues.

Due to complications created by the amount of time and space required to administer these assessments, a third test, the EFT, is more widely used. Subjects are shown one simple figure and then a more complex figure. The task of the subject is to find the simple figure in the more complex figure.
The educational implications of this model are that people with field-independent learning style should be able to learn with fewer contextual cues, while field-dependent learners are more likely to rely on them. Witkin et al. (1977) was among the first cognitive styles researchers to suggest that teaching and learning styles could be matched to improve student outcomes.

In an analysis of six studies that utilized the field-dependence-independence learning style model to investigate the possible effect of matching learning styles on learning outcomes, Hayes and Allinson (1996) found that two of the studies demonstrated a significant relationship while four did not.

Smith expresses concern that the field-dependence-independence model is actually a culturally and gender biased description of ability that favors males from middle and upper class backgrounds (2002). Smith also argues that the use of the Witkin’s work to formulate spatial components of IQ tests illustrates how being field-independent is perceived as being better than field dependent, because people who demonstrated field-independent qualities on an IQ test would earn higher scores (2002).

These studies illustrate the need for this study because (a) the field-dependence-independence model is already among the most thoroughly researched models, (b) assessment methods are subject to gender and culture bias, (c) the studies did not relate to technology training, and (d) a majority of the studies did not indicate a link between learning styles and learning outcomes.
Activity-Centered Approaches

Although the terms cognitive style and learning style are often considered interchangeable, Sternberg and Grigorenko consider learning styles a subset of cognitive styles (1997). This designation is based on the assumption that learning is an activity, an assertion made by Kolb in his Experiential Learning Model.

Kolb’s Learning Styles Inventory

According to Kolb, the learning process consists of “concrete experience, reflective observation, abstract conceptualization, and active experimentation” (Boyatzis & Kolb, 1991, p. 279). The Kolb Learning Styles Inventory (LSI), which consists of 12 items, measures the reliance of an individual on each of the four stages (Takacs, Reed & Wells, 1999). The two most prominent stages for each individual combine to define his or her learning style. Under this model, one may be a diverger, assimilator, converger, or accommodator (Cano-Garcia & Hewitt-Hughes, 2000; Terrell, 2002). Divergers prefer concrete experiences, assimilators “create models for tasks at hand,” convergers conceptualize abstractly and actively experiment, and accommodators learn through processes (Takacs et al., 1999, p. 2).

The LSI has also been applied in research related to computer users. In an analysis of five studies completed before 1990, Hayes and Allinson (1996) found that all five indicated that there was some interaction between learning style and achievement.
Wang, Hinn, and Kanfer (2001) found no significant difference between Kolb learning style groups on an achievement test taken by 31 participants following a class that utilized a computer program to facilitate online collaboration.

Takacs et al. (1999) found no relationship between learning style on Internet and hypermedia attitudes in a study involving thirteen teachers who were participating in a three week multimedia institute. Analysis of variance (ANOVA) was used, with the Kolb learning styles serving as the categories and results of an Internet and multimedia stages of concern assessment used to represent attitudes among the teachers in the sample. The relatively small sample size leads to questions regarding the results of this study.

Using a sample of 159 computing technology in education doctoral students enrolled in a distance learning/limited residency program, Terrell found that there was a relationship between learning style and completion rate (2002). The study featured the use of ANOVA and independent-samples t-tests. Terrell cautioned, however, that the Kolb LSI has been widely criticized for construct validity (2002).

The studies described in this section also illustrate the need for this study. Each of the samples described in this section was subject to sample bias due to self-selection. Arguably, individuals who would enroll in an online class, a three-week multimedia institute, or an educational technology doctoral program would have the interest, skills, and equipment necessary to be successful in their endeavors. This study measured technology-related attributes and cognitive styles for PK-4 teachers who took
assessments at faculty meetings. It is possible that wider access to more teachers reduced the risk of sample bias due to self-selection.

Dunn and Dunn

Sternberg and Grigorenko assert that the learning styles model proposed by Dunn and Dunn is also considered an activity-based model based on the active nature of learning. This model is oriented to the way in which an individual reacts to environmental factors related to the acquisition of new information (Howard, 1998; Kaplan & Kies, 1995; Sims & Sims, 1995). The test consists of 100 true/false items and includes 24 different scales organized into five categories, which include environmental, emotional, physical, sociological, and psychological elements (Sims & Sims, 1995). Gordon collectively considers the physical and environmental dimensions one of four elements instead of two of five (1998). Different versions of the test are available for use with adults, students in grades one and two, and grades three through five (Sims & Sims, 1995).

In a study involving 87 elementary and secondary teachers, Raupers (1999) found that teachers performed better on a posttest following a six-hour technology workshop when exposed to a culminating activity designed for their unique learning styles, as assessed using the Productivity Environmental Preference Survey (PEPS) (Dunn, Dunn & Price, 1991; Raupers, 1999). This study suggests that technology classes that are structured to accommodate different learning styles may better meet the needs of adult learners.
This study, however, was focused on the way in which learners react to their environments. Sternberg and Grigorenko observe that the Dunn and Dunn model refers “more to elements that affect a person’s ability to learn than to ways of learning” (2000, in Sternberg & Zhang, p. 17). Such elements include the temperature of the room and the emotional state of the participants. The focus of this study was to determine how the ways in which people perceive and order perceptions from the outside world may be related to their technology beliefs and use patterns.

**Personality-Centered Approaches**

A third approach to cognitive styles research is focused on exploring a possible link between personality and ability (Sternberg & Grigorenko, 1997). Personality-centered approaches include those that, although they may influence or impact cognitive processes, are rooted in personality traits (Sternberg and Grigorenko, 1997).

**Myers-Briggs Type Indicator**

The Myers-Briggs Type Indicator is derived from one personality-centered model based on Jung’s personality types (Carland, 1990; Myers & McCaulley, 1989). The original form of the instrument was developed by the mother-daughter team of Katherine Cooke Briggs and Isabel B. Myers (Hess, 2001). Participants take a “96 item, forced choice, self-scoring” test (Chambers, Hardy, Smith & Sienty, 2003, p. 186). One may be one of eight types, which is based on four individual subscales: introversion and extraversion; sensing and intuitive; thinking and feeling; and judging and perceiving (Carland, 1990). Moreland (1990) asserted that individuals might struggle with
technology because of their personality types and encouraged trainers to use intervention strategies tailored to each type.

Carland and Carland (1990) completed a study involving 54 males and 38 females majoring in computer information systems (CIS). The results indicated that ISFP males and ESFP females were most prevalent in the program to a significant degree. ISFP individuals are described as “retiring, quiet, sensitive, modest, loyal, tolerant . . . relaxed,” and ESFP individuals are “outgoing, friendly, easygoing, accepting . . . practical” (Carland & Carland, 1990, p. 121). The authors caution, however, that the results of the study cannot be extrapolated to a larger group of students because the sample was limited to one university and selected based on which instructors of CIS classes would allow their students to be polled (Carland & Carland, 1990).

In a 1993 study involving 172 secondary teachers in northeast Texas, Smith and Munday (1995) found that intuitive and thinking types of teachers were more willing to use technology than sensory types who are considered more practical in their orientation. Sensory/feeling types were least likely to be comfortable with technology. Chambers (et al., 2003) used the MBTI and the questionnaire developed by Smith and Munday (1995) to investigate whether certain personality types within a group of 200 emergency certified teachers were more open to using technology. They also found that intuitive/thinking types were most likely to be comfortable with technology, while sensory/feeling types were least likely to be comfortable (Chambers et al., 2003). The study utilized one-way ANOVA to analyze the 164 responses. Ironically, according to
Carland and Carland’s study, college juniors and seniors with these types were most prevalent among computer information systems majors at the university that was the subject of their study.

The studies described in this section are similar to this study, in that several of them involved PK-12 teachers, personality characteristics, and perceptions about technology. This study is distinct, however, in that it also investigated the technology needs, beliefs, levels of adoption, software expertise, and feelings of competence related to educational technology among a larger sample of elementary teachers. This study also used a different model for assessing style, which encompasses both personality characteristics and cognitive style.

Gregorc Style Delineator

The Gregorc Style Delineator™ (GSD) instrument (Gregorc Associates, Inc., Columbia, CT, http://www.gregorc.com) is also considered a personality-centered approach to cognitive styles research (Sternberg & Grigorenko, 1997). The mind-styles research completed by Gregorc may be considered a model of learning styles that includes elements of personality and cognition as reflected in behavior.

Gregorc explains that "learning style consists of distinctive behaviors which serve as indicators of how a person learns from and adapts to his environment” (1979, p. 234). To make sense of one’s environment, an individual uses different channels within the human mind to “receive and express information most efficiently and effectively” (Gregorc, 1982a, p. 5). The combination of attributes that enables one
to use a given set of channels is called one’s mediation abilities, and the behaviors that result from the use of these abilities are collectively known as one’s style (Gregorc, 1982a, p. 5). The model classifies individuals with respect to how they take in information, which is known as perception, and the way in which they organize it, which is known as ordering (Gregorc, 1982a, p. 5).

The perceptual quality of abstractness measures the degree to which one is able to use reasoning ability to sense the world around him or her. This quality also encompasses a person’s awareness of his or her internal reality, which could also be considered the ability to get in touch with one’s own feelings (Gregorc, 1982a).

In contrast, concreteness is a term used to describe the ability to take in information through the “physical senses of sight, smell, touch, taste, and hearing” (Gregorc, 1982a, p. 5). One who perceives concretely senses that which actually exists in the physical world.

According to Gregorc (1982a), the other component of one’s mind style is the way in which he or she arranges information once it is brought into the mind. People who are sequential find organizational tasks easy to complete, and they order information in a logical and incremental manner. The interpersonal communications of sequential people are also characterized by precision and logic (Gregorc, 1982a).

In contrast, people who are random are more likely to organize data in nonlinear chunks without regard to any prearranged plan. People with this quality also tend to
rapidly redirect their attention from one piece of data to another, and simultaneously process data from a variety of sources at once (Gregorc, 1982a).

The synthesis of the two dominant qualities within the perceptual and ordering domains results in the four channels in the Gregorc model. These include concrete sequential (CS), abstract sequential (AS), abstract random (AR), and concrete random (CR) (Gregorc, 1982b).

CS is the most common mind style. People who share it thrive on structure; they are most comfortable learning skills and completing tasks that are accompanied by step-by-step directions and clear criteria for what is considered mastery or successful completion. Possible positive characteristics include good organizational skills and proficiency with handling details. Possible shortcomings of the CS mind style include rigidity and a heavy-handed leadership style characterized by a tendency to micromanage (Gregorc, 1997).

People with the AS mind style are considered more academic, philosophical, and analytical in their orientation. They are thoughtful people who ask questions; they prefer to know why they have been instructed to learn a skill or complete a task as well as how they are supposed to do it. Strengths of an AS may include a deep understanding of his or her chosen field and strong analytical skills. Shortcomings may include the perception among others that they have a tendency to fixate on and repeatedly challenge small parts of ideas that they do not perceive to be compatible
with their own. This prolonged questioning can slow the implementation of new initiatives (Gregorc, 1997).

The AR mind style is closely linked with human emotion. Those who share this mind style learn skills and perform tasks more readily when they relate well to their teachers or their supervisors. Strengths of ARs may include a gift for interpersonal relations, artistic creativity, and an ability to interpret the feelings of others. The disadvantages associated with this mind style include a lack of organizational skills, mood swings, and a poorly developed concept of time (Gregorc, 1997).

People with a CR mind style are likely to be competitive and intuitive innovators. They typically do not enjoy working with details or following routines, and they prefer to learn skills and complete tasks independently. Strengths of CRs may include possessing the attributes of visionary and driven leaders. Their weaknesses may include being overly competitive or taking excessive personal or professional risks (Gregorc, 1997).

Gregorc asserts that people may have a dominant mind style that reflects a preference for using one set of perceptual and organizational channels. He notes, however, that it is possible for people of a given mind style to put forth extra effort, or stretch, in order to successfully use other channels as well (Gregorc, 1982a). Stretching may take a variety of forms in a technology staff development scenario. Given the CS’s need for step-by-step instructions, stretching might be required for someone with this mind style to complete a task using a computer program without a set of written directions. Because ARs function better when they interact with others, stretching for
someone with this mind style might take the form of learning how to complete the same task without any human contact.

A variety of studies have utilized the Gregorc mind styles model to investigate the relationship between learning style and technology-related attributes. Ross and Shulz (1999) used a sample of 70 University of Calgary students drawn from more than four majors to investigate whether there was a relationship between the learning styles of students as measured by the GSD, learning outcomes, and/or human-computer interaction behaviors. The study also sought to determine whether differences in the domain knowledge of the students had a greater impact on outcomes than any impact related to learning style (Ross & Shulz, 1999). The investigation featured a computer-assisted instruction (CAI) system that taught cardio-pulmonary resuscitation (CPR) procedures. The findings indicated that learning style did not have a significant impact on learning in a CAI environment. Using analysis of covariance (ANCOVA) to factor out the impact of prior knowledge, learning styles were found to have an influence on post-test scores. Ross and Shulz (1999) also observed that the participants who had been classified as AR interacted less with the computer program than the other three groups, while AS participants worked longer with the program and used more of its features. Although these observations were not statistically significant, they appear to suggest a need for further research.

Ester (1994) found that abstract learners performed significantly better using a lecture approach than they did using a computer-assisted instruction system designed
to teach the music-related anatomy, but he did not find a significant difference between
the achievements of people with different learning styles when the same instructional
methods were used. This study involved 33 male and 27 female undergraduate
students enrolled in music courses. Participants were sorted into sequential or random
categories based on their GSD scores and ranked by GPA within each category. Every-
other student was then assigned to lecture or CAI treatment groups based on his or her
ranking within his or her category. Students then either viewed a lecture and received
handouts or interacted with a CAI system that was created to cover the material.
Posttest results and learning style were analyzed using ANCOVA. These findings appear
to suggest that Random learners may perform better in instructional settings that
feature human instructors instead of machines.

This study differs from other research involving the GSD in that (a) it does not
analyze on the basis of all four Gregorc thinking styles, (b) the sample size of 60 was
notably smaller than the samples used in other surveys, and (c) Gregorc’s method for
determining a dominant learning style also was not used. The relative strength of the
learning styles of the participants was, therefore, not taken into account.

Ross, Drysdale, and Shulz (2001) investigated whether a relationship exists
between the academic performances of students in a variety of university courses at an
urban university with a student population of approximately 26,000. The findings of the
study that are of interest to this proposal involve student performance in Computer
Science 203: Introduction to Computers, which included a sample size of 804 students.
The breakdown of the participants’ learning styles was as follows: CS=327; AS=159; AR=156; CR=132. Dominant CS students earned a significantly higher GPA (2.98) than AR students (2.12); the average GPAs for CR and AS students were 2.50 and 2.83, respectively. The difference between the CS and AR average grade point averages were significant at the $p = .0001$ level. Seventy percent of the students who failed and 62% of the students who withdrew from the course were AR dominant. These results suggest that CS learners may be most proficient with computers, while AR learners may be most at-risk in computer-related courses. The authors conclude with a recommendation that instructors fashion their lessons to include strategies that facilitate learning for students with each of the different mind styles.

Ames (2003) also found a relationship between learning style and computer attitudes using a shortened form of the Computer Attitude Scale (CAS) and the GSD. The study initially involved the responses of 232 out of 1,028 university students. This study differed from previous research completed using the GSD in that the wording of the instrument was changed so that it included complete sentences instead of isolated words. Also, analysis was restricted to sets of scores that not only reflected one dominant learning style but also were at least five points greater than the next highest score. The study found that ASs were “more confident, less anxious, and more favorably disposed to instruction via computer,” while AR and CR learners were “less inclined to be receptive to technology-facilitated instruction” (Ames, 2003, p. 10). Because women in the sample population were more likely to be AR learners, Ames also
called for more research into a possible relationship between learning styles and attitudes toward technology. He also suggested that interventions based on such research might help women to feel more comfortable taking technology courses (Ames, 2003).

One consistent finding among these studies is that AR learners do not appear to function as well in environments that involve computer equipment, or learn as well in classes that address computer topics, as other types of learners. This in turn suggests that there may be a relationship between the technology-related attributes of teachers and their learning styles.

Summary

This literature review has illustrated that a relationship may exist between cognitive style and several key technology-related attributes among teachers. Due to the small number of studies that have made use of the GSD, research has been drawn from cognitive-centered, activity-centered, and personality-centered traditions within the field of cognitive styles research, as identified by Sternberg and Grigorenko (1997). Findings are not universally consistent, but they do provide reason to believe that people with different learning styles may react differently to training based on their styles (Hayes & Allinson, 1997).

This body of research also illustrated the need for this study. There have been only a handful of studies regarding the link between learning styles, as defined by the
Gregorc model, and the factors related to computer use that are similar to those described in this proposal. Most studies utilize other measures of cognitive style.

In addition, many of the scholars who have used the GSD have done so in ways not recommended by the author. Unauthorized changes include modification of the questions, mailing the GSD instead of administrating it in person, and/or changing the methodology for determining when a score reflects a dominant learning style. The result is that no prior studies have been undertaken using Gregorc’s original methodology with this combination of variables -- technology-related needs, beliefs, stages of adoption, software expertise, and technology competencies -- with a sample of elementary school teachers. The use of an elementary teacher sample is important, based on the findings by Norris et al. (2003) findings that secondary teachers were more likely to use technology instructionally than their elementary colleagues.
CHAPTER 3

METHODOLOGY

Purpose

The purpose of this research project was to determine whether a relationship exists between the learning styles of elementary school teachers and their technology-related needs, beliefs about technology, degrees of use of educational technology, and software proficiency.

Hypotheses

The study was designed to test the following hypotheses:

1. There is no significant difference between the dominant learning styles of teachers and their responses to survey questions about their technology-related needs.

2. There is no significant difference between the dominant learning styles of teachers and their responses to survey questions related to their beliefs about technology.

3. There is no significant difference between the dominant learning styles of teachers and the stage of adoption for educational technology with which they identify.

4. There is no significant difference between the dominant learning styles of teachers and their scores on a software expertise survey.
5. There is no significant difference between the dominant learning styles of teachers and their scores on a survey related to their feelings of competence about using technology in educational settings.

Research Participants

This study sought to determine the relationship between learning styles and technology-related characteristics of teachers. The targeted population of this study was teachers employed by the Mansfield Independent School District, a suburban PK-12 school system located within the Dallas-Fort Worth metropolitan area, during the 2003-2004 school year.

Initially, 508 teachers participated in the study. The target population was selected for several reasons. The configuration of grade levels on school campuses varies across the United States. However, most configurations include grades pre-kindergarten through four at the elementary level. Accordingly, elementary schools in the subject district were selected as the population for this study because they utilize a PK-4 configuration. The study included teachers of grades pre-kindergarten through four, reading specialists, and teachers of special education, music, Spanish, art, and physical education.

Teachers who were absent on the day of testing or opted not to participate in the study were considered non-participants. The results of nine surveys were eliminated from analysis because four were completed by paraprofessionals, two were completed by administrators, and three included incorrectly completed Gregorc Style
Delineator™ (GSD) instruments (Gregorc Associates, Inc., Columbia, CT, http://www.gregorc.com). Individual surveys that were not completed properly or did not reflect a dominant learning style were not included in the analysis. As a result, 499 teachers (21 males, 478 females, one of unknown gender) were included in the study.

Instrumentation

Learning Style

Learning style was assessed using the research version of the GSD. This instrument is used to determine how an individual prefers to receive and process information (Gregorc, 1982). The four styles are concrete sequential (CS), abstract sequential (AS), abstract random (AR), and concrete random (CR). Permission to use this instrument was secured from the author.

The GSD included ten sets of four words, which participants were asked to rank in order of preference. Each word was identified with a learning style. Sub scores for each learning style were tabulated. A learning style was considered dominant if the score is greater than 27 on a learning styles subscale (Gregorc, 1982b).

According to Gregorc (1997), people who share a style are likely to approach cognitive functions in similar ways. CS learners function best in environments characterized by a relatively high degree of organization and structure. They learn best when directions and criteria for successfully mastering a skill are clear. Positive characteristics include good organizational skills and being detail-oriented. Possible challenges include perceived inflexibility (Gregorc, 1997).
AS learners share a more analytical and philosophical approach to learning (Gregorc, 1997). Gregorc notes that they are likely to ask why they are being asked to learn a new skill. AS learners are knowledgeable and have good analytical skills, but their tendency to ask questions can slow the implementation of new programs (Gregorc, 1997).

AR learners tend to share a greater focus on human emotions (Gregorc, 1997). They learn best when they relate well to instructors. ARs may work well with others, have artistic gifts, and have the ability to interpret feelings. ARs may also struggle with mood swings, the development of organizational skills, and the management of their time (Gregorc, 1997).

CR learners are intuitive and competitive (Gregorc, 1997). They avoid working with details and following routines. They also may prefer to work independently. CR learners can be driven leaders with vision. The tendencies of CRs to take excessive risks and compete too intensely are considered potential drawbacks for members of this group (Gregorc, 1997).

A study involving 110 adults who took and then retook the test after allowing between six hours and eight weeks to elapse was used to assess the reliability of the instrument (Gregorc, 1982). The following standardized alphas were reported:
Table 2

*Standardized Alphas for the GSD*

<table>
<thead>
<tr>
<th>Type</th>
<th>First Administration</th>
<th>Second Administration</th>
<th>Correlation Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>.92</td>
<td>.92</td>
<td>.85</td>
</tr>
<tr>
<td>Sequential</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstract</td>
<td>.89</td>
<td>.92</td>
<td>.87</td>
</tr>
<tr>
<td>Sequential</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstract</td>
<td>.93</td>
<td>.92</td>
<td>.88</td>
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<td>.91</td>
<td>.87</td>
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<tr>
<td>Random</td>
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</tbody>
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(Gregorc, 1982)

The following study was used to assess reliability:

A total of 123 subjects who took the *Style Delineator* rated the resulting descriptions of themselves on a 1 to 5 scale labeled Strongly Agree, Agree, Unsure, Disagree, and Strong Disagree. Of the sample, 29% Strongly Agreed with the Description, 57% Agreed, 14% were Unsure, and none Disagreed either partially or strongly. (Gregorc, 1982)
Benton (nd) has questioned this study due to the fact that the sampling method was not reported, and he notes that the time allowed for administration of the assessment is listed as three minutes on the audiotape marketed for use with the product and four minutes in the authorized manual. Ferro (nd, p. 1) states, however, “in spite of the concerns raised . . . the Gregorc Style Delineator should prove serviceable if used according to its proclaimed purpose, as a self-assessment instrument” (p. 6). Ferro (nd) also notes that James and Blank (1993) credit the instrument with reflecting a solid research base, reasonable evidence of validity and reliability, and recommend its use.

Needs, Beliefs, Stages of Adoption, Software Expertise

An adapted version of the Snapshot Survey was used to assess the needs of teachers related to educational technology, their beliefs about technology, the degree to which they have adopted it for use in the classroom, and the degree of their expertise with commonly used applications. The Snapshot Survey was developed by Dr. Cathleen Norris of the University of North Texas and by Dr. Elliot Soloway of the University of Michigan (Norris & Solloway, 1999).

The Snapshot Survey consists of four sections. It includes a twelve-item needs assessment; an eight-item assessment of the respondents’ beliefs about technology; the one-item Concern-Based Adoption Model Level of Use (CBAM LOU) assessment regarding the degree to which teachers have adopted technology in the classroom; and a sixteen-item assessment of their software expertise on commonly used applications (Norris & Solloway, 1999). All of the items, with the exception of the CBAM LOU, are
scored using a five-point Likert-type scale (Norris & Solloway, 1999). Box (1999) used version 3.1 of the survey with a sample of 72 high school teachers. Version 3.1 is similar to the instrument used in the study in that it includes the same items used to assess beliefs, urgency of technology needs, and stages of technology adoption (Box, 1999). Version 3.1 also includes a section about technology use patterns in classrooms. The version used in the this study did not include this section. Box notes that, “Internal consistency reliability (Cronbach’s alpha) for the 25 scaled items was calculated at .72” (1999, p. 1).

There are six levels of adoption identified on the CBAM. The CBAM Levels of Use (CBAM LOU) assessment was adapted by Norris and Soloway from Hall and Rutherford (1974). According to Knezek, Christensen, Miyashita, and Ropp (2000), it is not possible to calculate internal consistency reliability for the CBAM-LOU because it contains only one item.

The wording of item 2 on the Needs Assessment section of the Snapshot Survey was modified to render it more appropriate for the population surveyed. Respondents were asked about the degree to which they “Need more time to change the curriculum to better incorporate the technology” (Norris & Soloway, 1999). The Texas Essential Knowledge and Skills (TEKS) are the state-required learning objectives for all students in the State of Texas and cannot be changed. Because the wording might lead to the impression among the respondents that they were being asked whether they needed to change the TEKS, the item was rewritten to read, “Need more time to plan lessons to
better incorporate the technology” (Appendix E). Cronbach’s alpha for the 12 scaled items on the needs component of the Snapshot Survey was calculated as .80.

The Assessment of Software Expertise was also modified to include more recent software packages that are used for instructional and administrative purposes on elementary campuses in the Mansfield Independent School District (Appendix E). This modified form of the Assessment of Software Expertise portion of the Snapshot Survey, which includes 16 items, had a Cronbach’s alpha of .83.

**Competency**

The Technology in Education Competency Survey (TECS) was used to assess the degree to which teachers perceived themselves to be proficient in the use of technology for educational purposes (Christensen, 1999). It is a self-assessment that contains nine items and has demonstrated “an internal consistency reliability estimate of .92 across 188 preservice educators and 40 university faculty” (Knezek, et al., 2000, p. 39, citing Christensen & Knezek, 2000). The Institute for the Integration of Technology into Teaching and Learning (IITTL) Web site lists the source of the criteria as a survey published by the International Society for Technology in Education (1999). Knezek et al. (2000) list the source of the criteria assessed on the survey as the National Council for the Accreditation of Teacher Education. Scores for each subscale on the Snapshot Survey, and for the TECS as a whole, were tabulated.
Copies of the demographic, Snapshot, and TECS surveys are included in Appendix E. The GSD has not been included in the appendix, because the conditions of its use for this study did not permit it.

Procedures

Permission to conduct this research project was secured from the Mansfield ISD on February 6, 2004 and from the Institutional Review Board (IRB) of the University of North Texas on February 12, 2004 (Appendices A and B). Each of the 12 elementary campuses in Mansfield ISD held after-school faculty meetings during the spring semester of 2004 for the purpose of data collection. Data collection did not occur until permission had been secured from both the Mansfield ISD and the IRB.

The GSD, the Snapshot Survey, and the TECS were administered to certified teachers at each of the 12 Mansfield ISD elementary schools during the spring 2004 semester. Data collection took place during after-school faculty meetings held at each campus. The GSD could not be administered online because of the author’s concerns for validity, reliability, and copyright protections. Concern that administration of one part of the study online and the other parts in person would increase the probability of errors in the study led to the decision to collect all data using paper forms.

The time required to review directions, complete the surveys, and turn them in was approximately 25 minutes on each campus. Teachers picked up sets of survey documents as they entered the rooms in which the faculty meetings were held. In order to prevent teachers from beginning to complete the survey documents before
procedures could be explained, a cover sheet was attached to each set. A transparency was placed on the overhead projector so that the participants’ attention would be directed to it. The cover sheet included a list of all instructions, the first of which was that the packet not be opened until all directions had been reviewed by the researcher (Appendix C).

The researcher reviewed directions for the survey packet at each of the 12 faculty meetings. It was explained that the first two pages were University of North Texas IRB release forms (Appendix B). The purposes of the study were stated, the potential risks were described, and questions were answered. Participants were shown how to properly complete the release forms and asked to sign, initial, and date their forms in the appropriate, highlighted blanks.

Next, the directions for the GSD were reviewed using the procedures described in the GSD administration guide. The directions for the Demographic Information Questionnaire, Snapshot Survey and TECS were reviewed (Appendices D, E, and F).

Question 10 on the demographic section of the survey required special instructions. This question was used by participants to record their dominant learning styles as identified by the GSD (Appendix D). On the GSD, a score of over 27 indicates that an individual has a dominant style (Gregorc, 1982b.). Participants whose highest scores were the same as one or more of their other three scores were asked to leave this question blank.
Participants were then provided with procedures for turning in the survey documents. They were asked to reassemble the directions, release form, GSD, and other surveys in their original order, affix the pages together using a paper clip, and place them in a red tray located at the front of the room.

As an incentive for completing the surveys, participants were offered the opportunity to place their names in a district-wide drawing for one $50.00 gift certificate and four $25.00 gift certificates from a book store. Perforated tickets were used for this purpose. The researcher explained that each participant would need to write his or her name and campus on one side of the ticket, tear it along the perforation, and place that portion of the ticket into the designated basket. Participants were encouraged to keep the second half of the tickets for themselves for future reference.

Participants then completed the six pages of surveys independently. On the GSD, they recorded their rankings and tabulated their scores. As instructed, participants used results from the GSD to shade in the circle that corresponded to their dominant learning style, if applicable. They used pencils to write or shade in the circles that corresponded to their responses, as appropriate to each form.

As remaining participants were completing their surveys, the respondents’ completed surveys were briefly checked for completeness and accuracy. If possible, incomplete surveys were returned to participants to be completed. Sets of surveys that did not include a properly completed GSD, as well as those completed by non-teaching
personnel such as paraprofessionals, administrators, and counselors, were excluded from analysis.

Once data collection had been completed at all campuses, release forms were separated from the rest of the survey documents. Copies of release forms were made. Each set of survey documents was assigned a sequential number, which was written or stamped on each page of each set of survey documents. These steps were taken in order to preserve the privacy of the participants while providing a means of assuring that data for each participant would remain complete throughout processing.

Following data collection, a drawing was held for the incentive prizes. All tickets for the drawing were assembled and placed in one basket. Winning tickets were drawn, in the presence of a witness, on May 26, 2004. For each prize, a winner was selected. Copies of the release forms and prizes for the drawing were provided to participants on each campus on May 27, 2004. The superintendent of Mansfield ISD received a copy of the results in October 2004.

As previously noted, it was not legal to administer the GSD online. It was also determined impractical to conduct part of the survey online and part on paper. In order to take advantage of the relative speed and accuracy of electronic data processing, however, survey forms were prepared for use with an optical scanner. This equipment is available for use by graduate students at the Data Entry Department at the University of North Texas. Responses for each page of the survey document were read by the
scanner and recorded into spreadsheet files. The data were analyzed during June and July 2004.

On the GSD, a score of 27 or more reflects a dominant learning style. As a result, the researcher manually reviewed data for all completed surveys and selected for analysis only those for which there was a GSD score of 27 or more. If a GSD included two or more scores with the same value, that set of surveys was also eliminated from analysis. This data verification step was taken in order to assure that the only data sets used in the analysis would include a dominant learning style. A total of 508 teachers initially participated in the study. The results of nine surveys were eliminated from analysis during data verification for reasons described in Chapter 4. As a result, 499 participants were included. During the course of this review of data, the researcher also keyed in an assigned sequential number for each data set and verified that the number corresponded to each set of surveys.

Data Analysis

All statistical data were analyzed using Statistical Program for the Social Sciences® (SPSS) statistical data analysis software, Version 10.0, 2000 (SPSS, Inc., Chicago, IL, http://www.spss.com). In order to describe the targeted population, descriptive data were generated for the following demographic items: years of teaching experience, gender, years of teaching experience in the Mansfield ISD, teaching assignment, number of credit hours of technology-related instruction in teacher certification program, number of clock hours of technology-related instruction in other
districts (if applicable), number of clock hours of technology instruction in the Mansfield ISD, age, highest level of education, and learning style. Descriptive data also included frequencies, means, sample sizes, standard deviations, and variances. The .05 alpha level was applied to all data as the standard for significance.

Independent Measures

1. The learning styles of participants were treated as the independent variable.

Dependent Measures

1. The self-perceived technology needs of participants were treated as a dependent variable.

2. The self-perceived beliefs of participants about the uses of computers in the classroom were treated as a dependent variable.

3. The participants’ self-perceived stages of adoption of educational technology were treated as a dependent variable.

4. The participants’ self-perceived proficiencies with computer applications widely used within their school district were treated as a dependent variable.

5. The participants’ self-perceived proficiencies using technology in educational settings were used as a dependent variable.

A one-way analysis of variance (ANOVA) was used to test hypotheses one, two, three, four, and five. To test hypothesis one, means were compared between the four learning style groups to determine whether there was a significant difference between the groups regarding their self-perceived technology-related needs. To test hypothesis
two, means were compared between the four learning style groups to determine whether there was a significant difference between the groups regarding their self-perceived beliefs about educational technology. To test hypothesis three, scores of the four learning style groups were compared to determine whether there was a significant difference between the groups regarding their self-perceived stages of adoption of educational technology. To test hypothesis four, means were compared between the four learning style groups to determine whether there was a significant difference between the groups regarding their self-perceived proficiency with computer applications widely used within the school district. To test hypothesis five, means were compared between the four learning style groups to determine whether there was a significant difference between the groups regarding their self-perceived competencies related to the use of computers in an educational setting. Levine’s homogeneity of variance test was conducted to ensure that differences among the means related to the measures used were not sufficiently similar to permit comparison.
CHAPTER 4
ANALYSIS OF DATA

Introduction

The following hypotheses were tested during the course of this investigation:

1. There is no significant difference between the dominant learning styles of teachers and their responses to survey questions about their technology-related needs.

2. There is no significant difference between the dominant learning styles of teachers and their responses to survey questions related to their beliefs about technology.

3. There is no significant difference between the dominant learning styles of teachers and the stage of adoption for educational technology with which they identify.

4. There is no significant difference between the dominant learning styles of teachers and their scores on a software expertise survey.

5. There is no significant difference between the dominant learning styles of teachers and their scores on a survey related to their feelings of competence about using technology in educational settings.
Description of the Study Population

A total of 508 teachers participated in the study. The results of nine surveys were eliminated from analysis because four were completed by paraprofessionals, two were completed by administrators, and three included incorrectly completed Gregorc Gregorc Style Delineator™ (GSD) instruments (Gregorc Associates, Inc., Columbia, CT, http://www.gregorc.com). As a result, 499 participants were included in the population.

The description of the group was based on ten demographic items. Respondents were asked to report their years of classroom experience, gender, years that they had worked in the district, current teaching assignment, number of credit hours of technology-related instruction in their teacher certification programs, number of clock-hours of technology related instruction received in other districts (if applicable), number of clock-hours of technology training received in their current district, age, highest level of education attained, and dominant learning style (if applicable).

Some of the surveys were incomplete. Testing the hypotheses required a comparison of individual variables among groups of teachers with different GSD styles. Incomplete data for any one variable other than the GSD, therefore, did not exclude analysis of the data that was complete for the purpose of testing the other hypotheses.

The largest percentages of teachers were female and between the ages of 26 and 40. Table 3 indicates the number and percentage of teachers of each type that participated in the study.
Table 3

Demographic Frequencies of Gender and Age

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>21</td>
<td>4.2</td>
</tr>
<tr>
<td>Female</td>
<td>477</td>
<td>95.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-25</td>
<td>33</td>
<td>6.6</td>
</tr>
<tr>
<td>26-30</td>
<td>81</td>
<td>16.3</td>
</tr>
<tr>
<td>31-35</td>
<td>90</td>
<td>18.1</td>
</tr>
<tr>
<td>36-40</td>
<td>87</td>
<td>17.5</td>
</tr>
<tr>
<td>41-45</td>
<td>56</td>
<td>11.3</td>
</tr>
<tr>
<td>46-50</td>
<td>58</td>
<td>11.7</td>
</tr>
<tr>
<td>51 +</td>
<td>92</td>
<td>18.5</td>
</tr>
</tbody>
</table>

Table 4 depicts the demographic frequencies of educational level. A total of 253 of the teachers (51.3%) had completed a Bachelor’s degree only; 135 (27.4%) had taken some graduate classes; 99 (20.1%) had earned a Master’s degree. None of the teachers who participated in the study had completed an earned doctorate, although six (1.2%) reported having completed some classes at the doctoral level.
Table 4

Demographic Frequencies of Educational Level

<table>
<thead>
<tr>
<th>Educational Level</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor’s degree</td>
<td>253</td>
<td>51.3</td>
</tr>
<tr>
<td>Some graduate classes</td>
<td>135</td>
<td>27.4</td>
</tr>
<tr>
<td>Master’s degree</td>
<td>99</td>
<td>20.1</td>
</tr>
<tr>
<td>Some doctoral work</td>
<td>6</td>
<td>1.2</td>
</tr>
<tr>
<td>Doctoral degree</td>
<td>0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Table 5 indicates the number of years of classroom experience for teachers in the sample and their teaching assignments. The demographic data indicates that the largest group of teachers in the sample, 144 (29.0%), had one to five years of classroom teaching experience. The next largest group, 118 (23.7%), had six to ten years of experience. Slightly more than half of the participants (52.7%) had ten years or less of teaching experience.

This table also indicates that teachers from each of the elementary grade levels and related departments participated in the study. The term *specialists* is used to describe reading specialists and teachers of physical education, music, Spanish, and art.
Table 5

Demographic Frequencies of Years of Classroom Experience and Teaching

Assignment

<table>
<thead>
<tr>
<th>Years of experience</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>144</td>
<td>29.0</td>
</tr>
<tr>
<td>6-10</td>
<td>118</td>
<td>23.7</td>
</tr>
<tr>
<td>11-15</td>
<td>90</td>
<td>18.0</td>
</tr>
<tr>
<td>16-20</td>
<td>62</td>
<td>12.5</td>
</tr>
<tr>
<td>20 +</td>
<td>83</td>
<td>16.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teaching Assignment</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>PK/K</td>
<td>88</td>
<td>17.7</td>
</tr>
<tr>
<td>Grade 1</td>
<td>67</td>
<td>13.5</td>
</tr>
<tr>
<td>Grade 2</td>
<td>79</td>
<td>15.9</td>
</tr>
<tr>
<td>Grade 3</td>
<td>74</td>
<td>14.9</td>
</tr>
<tr>
<td>Grade 4</td>
<td>64</td>
<td>12.9</td>
</tr>
<tr>
<td>Special Education</td>
<td>55</td>
<td>11.1</td>
</tr>
<tr>
<td>Title I</td>
<td>10</td>
<td>2.0</td>
</tr>
<tr>
<td>Specialists*</td>
<td>60</td>
<td>12.1</td>
</tr>
</tbody>
</table>

* The term *specialists* is used to describe reading specialists and teachers of physical education, music, Spanish, and art.
Figure 1 depicts the relative size of the learning style groups. They are listed as a percentage of the total sample size. The largest group was concrete sequential (CS) (43.1%), followed by abstract random (AR) (24.1%), concrete random (CR) (21.3%), and abstract sequential (AS) (7.6%). The figure also indicates that 4% of respondents did not report a dominant learning style.

Participants who failed to complete the GSD properly were excluded from analysis entirely. It was possible to conduct analysis with missing values for the items related to other variables. Because dominant learning style was the only independent variable, however, it was necessary to have an appropriate value for each set of surveys subjected to analysis.

As previously mentioned, the critical nature of the GSD reduced the number of study participants. Three teachers incorrectly completed the GSD. Their results were not included in the study, which reduced the number of participants to 505. Results submitted for two administrators and four paraprofessionals were eliminated from the study without regard to whether the GSD had been correctly completed, because those positions were not part of the target population. The final number of participants included in the study, therefore, was 499.
Table 6 indicates the number of participants within each learning style who had average scores on the needs assessment that fell within the following parameters: 1.00-1.99; 2.00-2.99; 3.00-3.99; 4.00-5.00. The lowest possible average score on the needs assessment is a value of one, and the highest possible value is five. An average score of one indicates that the participant considers all of his or her technology-related needs assessed using the instrument as being the least urgent. An average score of five indicates that the participant considers all of the possible technology-related needs assessed using the instrument as most urgent. In the table below, participants within
each learning style group are classified based on their mean needs scores. Of the 500 sets of responses submitted on this assessment, 457 were complete. This accounts for 91.4% of the sample. There were 43 missing cases, which accounts for the remaining 8.6%.

Table 6

*Study Participants Classified by Mean Needs Scores and GSD Styles*

<table>
<thead>
<tr>
<th>Range of Mean Needs Scores</th>
<th>Gregorc Styles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CS</td>
</tr>
<tr>
<td>1.00-1.99</td>
<td>8</td>
</tr>
<tr>
<td>2.00-2.99</td>
<td>57</td>
</tr>
<tr>
<td>3.00-3.99</td>
<td>114</td>
</tr>
<tr>
<td>4.00-4.99</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>202</td>
</tr>
</tbody>
</table>

Table 7 indicates the number of participants within each learning style who had average scores on the beliefs assessment that fell within the following parameters: 1.00-1.99; 2.00-2.99; 3.00-3.99; 4.00-5.00. The lowest possible average score on the beliefs assessment is a value of one, and the highest possible value is five. An average score of one indicates that the participant selected “Strongly Disagree” as the statement
that best reflects his/her beliefs with respect each of the eight belief statements on the assessment (Appendix E). An average score of five indicates that the participant selected “Strongly Agree” as the statement that best reflects his/her beliefs with respect each of the eight belief statements on the assessment (Appendix E). In the table below, participants within each learning style group are classified based on their mean beliefs scores. Of the 500 sets of responses submitted on this assessment, 460 were complete. This accounts for 92.0% of the sample. There were 40 missing cases, which accounts for the remaining 8%.

Table 7

*Study Participants Classified by Mean Beliefs Scores and GSD Styles*

<table>
<thead>
<tr>
<th>Range of Mean Beliefs Scores</th>
<th>CS</th>
<th>AS</th>
<th>CR</th>
<th>AR</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00-1.99</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>2.00-2.99</td>
<td>79</td>
<td>13</td>
<td>34</td>
<td>21</td>
<td>147</td>
</tr>
<tr>
<td>3.00-3.99</td>
<td>92</td>
<td>18</td>
<td>69</td>
<td>55</td>
<td>234</td>
</tr>
<tr>
<td>4.00-4.99</td>
<td>27</td>
<td>5</td>
<td>11</td>
<td>21</td>
<td>64</td>
</tr>
<tr>
<td>Total</td>
<td>204</td>
<td>37</td>
<td>118</td>
<td>101</td>
<td>460</td>
</tr>
</tbody>
</table>
Table 8 indicates the number of participants within each learning style who selected a stage of adoption assessment that fell within the following parameters: Level 0: Non-use; Level 1: Orientation; Level 2: Preparation; Level 3: Mechanical Use; Level 4 A: Routine; Level 4 B: Refinement; Level 5: Integration; Level 6: Renewal (Appendix E). The lowest possible stage of adoption on the assessment is Level 0: Non-use, and the highest possible value is Level 6: Renewal. There is only one item on this assessment, which eliminated the need to calculate an average (Appendix E). A stage of adoption of Level 0: Non-use indicates that the participant identifies with the following statement: “I have little or no knowledge of information technology in education, no involvement with it, and I am doing nothing toward becoming involved” (Appendix E). A stage of adoption of Level 6: Renewal indicates that the participant identifies with the following statement:

I reevaluate the quality of use of information technology in education, seek major modifications of, or alternatives to, present innovation to achieve increased impact, examine new developments in the field, and explore new goals for myself and my school district (Appendix E).

In Table 8, participants within each learning style group are classified based on their stages of adoption. Of the 500 sets of responses submitted on this assessment, 476 were complete. This accounts for 95.2% of the sample. There were 24 missing cases, which accounts for the remaining 4.8%.
Table 8

*Study Participants Classified by Stages of Adoption Scores and GSD Styles*

<table>
<thead>
<tr>
<th>Stage of Adoption</th>
<th>Gregorc Styles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CS</td>
</tr>
<tr>
<td>Level 0: Non-use</td>
<td>2</td>
</tr>
<tr>
<td>Level 1: Orientation</td>
<td>10</td>
</tr>
<tr>
<td>Level 2: Preparation</td>
<td>3</td>
</tr>
<tr>
<td>Level 3: Mechanical Use</td>
<td>40</td>
</tr>
<tr>
<td>Level 4 A: Routine</td>
<td>65</td>
</tr>
<tr>
<td>Level 4 B: Refinement</td>
<td>56</td>
</tr>
<tr>
<td>Level 5: Integration</td>
<td>32</td>
</tr>
<tr>
<td>Level 6: Renewal</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>213</td>
</tr>
</tbody>
</table>

Table 9 indicates the number of participants within each learning style who had average scores on the Software Expertise assessment that fell within the following parameters: 1.00-1.99; 2.00-2.99; 3.00-3.99; 4.00-5.00. The lowest possible average score on the beliefs assessment is a value of one, and the highest possible value is five. An average score of one indicates that the participant selected “I don’t know anything
about it” as the statement that best reflected his/her level of expertise with respect to
each of the 16 computer programs listed on the assessment (Appendix E). An average
score of five indicates that the participant selected “I use it for instruction on a regular
basis” as the statement that best reflected his/her level of expertise with respect to
each of the sixteen computer programs listed on the assessment (Appendix E). In the
table below, participants within each learning style group are classified based on their
mean software expertise scores. Of the 500 sets of responses submitted on this
assessment, 410 were complete. This accounts for 82.0% of the sample. There were 90
missing cases, which accounts for 18%.

Table 9

*Study Participants Classified by Software Expertise and GSD Styles*

<table>
<thead>
<tr>
<th>Range of Software Expertise Scores</th>
<th>Gregorc Styles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CS</td>
</tr>
<tr>
<td>1.00-1.99</td>
<td>34</td>
</tr>
<tr>
<td>2.00-2.99</td>
<td>117</td>
</tr>
<tr>
<td>3.00-3.99</td>
<td>30</td>
</tr>
<tr>
<td>4.00-4.99</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>182</td>
</tr>
</tbody>
</table>
Table 10 indicates the number of participants within each learning style who had average scores on the Technology in Education Competency Survey (TECS) assessment that fell within the following parameters: 1.00-1.99; 2.00-2.99; 3.00-3.99; 4.00-5.00. The lowest possible average score on the TECS assessment is a value of one, and the highest possible value is five. An average score of one indicates that the participant selected “Strongly Disagree” as the statement that best reflected his/her response to nine competency statements that begin with “I feel competent,” each followed by the description of a skill related to instructional technology (Appendix F). An average score of five indicates that the participant selected “Strongly Agree” as the statement that best reflected his/her response to nine competency statements that begin with “I feel competent,” each followed by the description of a skill related to instructional technology (Appendix F). In the table below, participants within each learning style group are classified based on their mean TECS scores. Of the 500 sets of responses submitted on this assessment, 467 were complete. This accounts for 93.4% of the sample. There were 33 missing cases, which accounts for the remaining 6.6%.
Table 10

Study Participants Classified by Mean Software Competency Scores and GSD Styles

<table>
<thead>
<tr>
<th>Range of Mean Competency Scores</th>
<th>Gregorc Styles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CS</td>
</tr>
<tr>
<td>1.00-1.99</td>
<td>3</td>
</tr>
<tr>
<td>2.00-2.99</td>
<td>25</td>
</tr>
<tr>
<td>3.00-3.99</td>
<td>88</td>
</tr>
<tr>
<td>4.00-4.99</td>
<td>94</td>
</tr>
<tr>
<td>Total</td>
<td>210</td>
</tr>
</tbody>
</table>

Data Analysis for Hypothesis 1

The first set of variables analyzed was the teachers’ self-perceived needs for implementing technology in the classroom as a function of their Gregorc learning styles. A one-way analysis of variance (ANOVA) was conducted. The relationship between learning style groups showed statistical significance with respect to the needs variable. There was a significant effect of learning style on needs $F(3, 456) = 4.873, \ p < .05$. Levene’s homogeneity of variances test statistic was $1.212, \ p > .05$, which appears to
support the assertion that the means were initially significantly similar to render comparison using statistical procedures possible.

Table 11

*ANOVA for Gregorc Learning Styles and Needs*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>908.815</td>
<td>302.938</td>
<td>4.873**</td>
</tr>
<tr>
<td>Within Groups</td>
<td>453</td>
<td>28159.124</td>
<td>62.161</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>456</td>
<td>29067.939</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** p < .01

Figure 2 provides a graphic representation of the difference between the means of the four learning style groups and the mean scores on the needs assessment as completed by the participants in each group. The self-reported needs of CS and AR learners were higher than those of AS learners.
The second set of variables analyzed was the teachers’ self-perceived beliefs about technology in the classroom as a function of their Gregorc learning styles. A one-way analysis of variance (ANOVA) was conducted. The relationship between learning style groups showed no statistical significance with respect to the beliefs variable. Levene’s homogeneity of variances test statistic was .130, $p > .05$, which appears to support the assertion that the means were initially significantly similar to render comparison using statistical procedures possible. Because the ANOVA revealed no significant differences between groups, it was unnecessary to conduct post hoc testing for the GSD learning style groups with respect to the beliefs variable.
Table 12

ANOVA for Gregorc Learning Styles and Beliefs

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>209.965</td>
<td>69.988</td>
<td>2.305</td>
</tr>
<tr>
<td>Within Groups</td>
<td>456</td>
<td>13844.946</td>
<td>30.362</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>459</td>
<td>14054.911</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3 depicts the similarity between the means of the four learning style groups with respect to the beliefs variable. The means for the CS, AS, and AR groups were within one-half point of one another.

The difference between the mean of the CR group and the means of the other three learning style groups is greater. Initially, the scale used in the bar graph might give the impression that the differences were greater than was actually the case. A closer examination of the graph reveals that the mean for the CR group was within two points of AR, the next highest group. This means that the CR teachers may have had more positive beliefs, on average, than the AR, AS, and CS groups. Any differences, however, were not determined to be statistically significant using the procedures previously described. The scale of the graph was not modified out of concern that compacting the length of each interval would completely mask the differences between the groups.
Data Analysis for Hypothesis 3

The third set of variables analyzed was the teachers’ self-perceived stages of adoption as a function of their Gregorc learning styles. A one-way analysis of variance (ANOVA) was conducted. The relationship between learning style groups showed statistical significance with respect to the stages of adoption variable. There was a significant effect of learning style on stages of adoption $F(3, 475) = 2.813, p < .05$. Levene’s homogeneity of variances test statistic was $.460, p > .05$, which appears to support the assertion that the means were initially significantly similar to render comparison using statistical procedures possible.
Table 13

ANOVA for Gregorc Learning Styles and Stages of Adoption

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>16.019</td>
<td>5.340</td>
<td>2.813*</td>
</tr>
<tr>
<td>Within Groups</td>
<td>472</td>
<td>895.819</td>
<td>1.898</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>475</td>
<td>911.838</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

A set of Tukey highest significant difference (HSD) tests was conducted to determine the specific learning style group or groups between which there had been a significant difference with respect to the stages of adoption variable. These tests, however, failed to reveal significant differences between the individual learning style groups at the *p < .05* level. A set of Fisher least significant difference (LSD) post hoc tests was used to detect these differences. The LSD tests identified significant differences between the following groups at the *p < .05* level: AS and AR (*p = .024*), AR and CR (*p = .017*), and AS and CR (*p = .021*). The differences between the other groups were not significant at the *p < .05* level.

Figure 4 provides a graphic representation of the difference between the means of the four learning style groups and the mean scores on the stages of adoption assessment as completed by the participants in each group. The AS group had the highest mean, followed by the CR, CS, and AR groups.
Figure 4. Mean Stages of Adoption Scores by GSD Styles

Data Analysis for Hypothesis 4

The fourth set of variables analyzed was the teachers’ self-perceived software expertise as a function of their Gregorc learning styles. A one-way analysis of variance (ANOVA) was conducted. The relationship between learning style groups showed statistical significance with respect to the software expertise variable. There was a significant effect of learning style on needs $F(3, 409) = 3.602, p < .05$. Levene’s homogeneity of variances test statistic was 1.690, $p > .05$, which appears to support
the assertion that the means were initially significantly similar to render comparison using statistical procedures possible.

A set of Tukey HSD tests was conducted to determine the specific learning style group or groups between which there had been a significant difference with respect to the software expertise variable. These tests revealed no significant differences between any of the learning style groups. A set of Fisher LSD post hoc tests was also conducted. It identified significant differences between the following groups at the \( p < .05 \) level: AS and AR \( (p = .024) \), and AR and CR \( (p = .017) \). The differences between the other groups were not significant at the \( p < .05 \) level.

Table 14

*ANOVA for Gregorc Learning Styles and Software Expertise*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>( F )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>723.148</td>
<td>241.049</td>
<td>3.602*</td>
</tr>
<tr>
<td>Within Groups</td>
<td>406</td>
<td>27168.130</td>
<td>66.197</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>409</td>
<td>27891.278</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*\( p < .05 \)

Figure 5 provides a graphic representation of the difference between the means of the four learning style groups and the mean scores on the software expertise self-assessment as completed by the participants in each group. It indicates that the AS
group reported having achieved the highest mean stage of adoption, followed by CR, AR, and CS groups.

*Figure 5.* Mean software expertise self-assessment scores by Gregorc learning style.

The fifth set of variables analyzed was the teachers’ self-perceived technology competencies as a function of their Gregorc learning styles. A one-way analysis of variance (ANOVA) was conducted. The relationship between learning style groups showed statistical significance with respect to the competency variable. There was a significant effect of learning style on needs $F(3, 456) = 3.209, p < .05$. Levene’s homogeneity of variances test statistic was $2.394, p > .05$, which appears to support
the assertion that the means were initially significantly similar to render comparison using statistical procedures possible.

Table 15

ANOVA for Gregorc Learning Styles and Competencies

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>426.658</td>
<td>142.219</td>
<td>3.209*</td>
</tr>
<tr>
<td>Within Groups</td>
<td>463</td>
<td>20520.866</td>
<td>44.322</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>466</td>
<td>20947.525</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

A set of Tukey HSD tests was conducted to determine the specific learning style group or groups between which there had been a significant difference with respect to the stages of adoption variable. These tests, however, did not reveal significant differences between the individual learning style groups at the *p < .05* level. A set of Fisher LSD post hoc tests was also used. It identified differences between the following groups at the *p < .05* level: CS and AS (*p = .043*), AS and AR (*p = .015*), and AR and CR (*p = .019*). The differences between the other groups were not significant at the *p < .05* level.

Figure 7 provides a graphic representation of the difference between the mean scores on the competency self-assessment as completed by the participants in each
group. The AS group reported the highest mean score on the competency self-assessment, followed by the CR, CS, and AR groups.

*Figure 7. Competency self-assessment scores by Gregorc learning style.*

ANOVA was used to determine whether significant differences existed between groups of teachers, grades pre-kindergarten through four, with respect to their mean scores on self-assessments related to the following variables: technology-related needs, beliefs about technology, levels of adoption of technology, software expertise, and technology competencies. These procedures indicated that there were significant differences between groups with respect to the needs, stages of adoption, software expertise, and technology competency variables. Tukey HSD post hoc tests were
performed for each variable in order to determine which groups, if any, differed significantly from one another. In several cases, the Tukey HSD tests were not effective at identifying differences between specific groups for which the analyses of variance had identified differences. As a result, Fisher LSD tests were conducted on each variable for which the ANOVA found significant differences between the learning style groups.

For the needs variable, the results of the Tukey HSD tests indicated that there were significant differences between the AS and CS groups and between the AS and AR groups. The Fisher LSD post hoc tests also found significant differences between the CS and AS groups and the AS and AR groups.

The ANOVA indicated that there was no significant difference between the four learning style groups on the beliefs variable. No additional analysis was conducted with respect to this variable.

The ANOVA detected a significant difference between the learning style groups on the stages of adoption variable. The Tukey HSD post hoc tests failed to identify significant differences between the individual groups. The set of Fisher LSD tests, however, identified significant differences between the following groups: AS and AR; AR and CR; AS and CR.

The ANOVA indicated a significant difference between the learning style groups on the software expertise variable ($p = .014$). The Tukey HSD post hoc tests failed to identify significant differences between the individual groups. Fisher LSD post hoc tests,
however, identified significant differences between the following groups: AS and AR; AR and CR.

The ANOVA indicated a difference between the learning style groups on the technology competency variable. The Tukey HSD post hoc tests failed to identify any significant differences between the groups. The Fisher LSD post hoc tests, however, identified differences between the following groups: CS and AS; AS and AR; AR and CR.
CHAPTER 5
SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The purpose of the study was to determine whether teachers with the same dominant learning style shared similar characteristics with respect to their self-reported beliefs about, and proficiency with, educational technology. Variables of interest included learning style, technology-related needs, beliefs, stages of adoption, software expertise, and competency. These variables were measured using the Gregorc Style Delineator™ (GSD) instrument (Gregorc Associates, Inc., Columbia, CT, http://www.gregorc.com), the Snapshot Survey, and the Technology in Education Competency Survey (TECS). Participants included teachers of grades PK-4, reading specialists, and teachers of music, Spanish, art, and physical education. All teachers included in the study worked in the Mansfield ISD, a suburban district in the Dallas-Fort Worth metropolitan area. The study was conducted in the spring semester of 2004.

Teachers at 12 elementary campuses were surveyed during after-school faculty meetings. A total of 499 participants completed the study. The subject group was also overwhelmingly female. A total of 477 of the participants, or 95.9%, were women; only 21 participants, or 4.2%, were male. A total of 253 of the teachers, or 51.3%, had completed a Bachelor’s degree; 99 of the teachers, or 20.1%, had also earned a Master’s degree. None of the participants had earned a doctorate. Data extracted from the demographic survey also indicated that among the sample of teachers, concrete
sequential (CS) was the most dominant learning style (43.1%), followed by abstract random (AR) (24.1%), concrete random (CR) (21.3%), and abstract sequential (AS) (7.6%).

Summary of Major Findings

1. The mean scores of participants on the needs assessment of the Snapshot Survey were significantly higher for CS, AR, and CR learners compared to those of AS learners.

2. The mean scores of participants on the beliefs assessment were not significantly different when compared between the learning style groups.

3. The mean scores of participants on the stages of adoption item were significantly higher for AS learners than AR learners and significantly higher for CR learners than AR learners.

4. The mean scores of participants on the software expertise assessment of the Snapshot Survey were significantly higher for AS learners than for CS learners or AR learners. The mean scores were also significantly higher for CR learners compared to CS learners.

5. The mean scores of participants on the software competency assessment were significantly higher for AS learners than for CS learners or AR learners and significantly higher for CR learners than AR learners.
Discussion of Findings

Data analysis procedures were complicated by the failure of the Tukey HSD post hoc test to pinpoint differences among specific groups that had been identified by analyses of variance (ANOVA). As a result, the Fisher LSD was utilized as a post hoc test to identify differences between groups on variables for which an ANOVA had identified a significant difference. The findings for each variable are discussed with respect to the findings of each test on each variable.

On the needs variable, both the Tukey HSD and the Fisher LSD tests indicated that there was a significant difference between the means scores of the AS, CS, and AR groups. Only the Fisher LSD test detected a difference between the AS and CR groups. The mean scores for the AS group were higher than those for the other groups.

For the beliefs variable, ANOVA detected no difference between the different learning style groups. As a result, no additional analysis was performed.

For the stages of adoption variable, the Tukey HSD failed to identify any differences between groups. Fisher LSD tests indicated that there was a significant difference between the AS and AR groups and the AR and CR groups. The mean scores for the AS group were higher than those of the AR group. The CR scores were significantly higher than the CR group.

For the stages of adoption variable, the Tukey HSD and Fisher LSD tests indicated that there was a significant difference between the CS and AS groups. The Fisher LSD found differences for this variable between the AS and CS groups, the AS
and AR groups, and AR and CR groups. The scores for the AS group were significantly higher than those of the AR and CS groups. The CR scores were significantly higher than those of the AR group.

Conclusions

1. It was determined that AS teachers reported significantly lower needs than their CS, AR, and CR colleagues. The null hypothesis was rejected.

2. The ANOVA performed on the data related to the beliefs variable did not detect any significant differences between the learning style groups. As a result, no additional analysis was performed and the null hypothesis was retained.

3. It was determined that AS teachers had significantly higher stages of adoption than AR teachers. CR teachers were determined to have significantly higher stages of adoption than AR learners. The null hypothesis was rejected.

4. It was determined that AS teachers reported significantly higher levels of software expertise than CS or AR teachers. CR teachers also reported significantly higher levels of expertise than AR teachers. The null hypothesis was rejected.

5. It was determined that AS teachers reported significantly higher levels of technology competency than CS or AR teachers. CR teachers also reported significantly higher levels of competency than AR teachers. The null hypothesis was rejected.
When evaluated in light of prior research on technology-related attributes and learning style, the findings of this study appear to suggest that members of the AS learning style group may be more capable and successful users of technology. In a study involving the Computer Attitude Scale, Ames (2003) found that AS learners were “more confident, less anxious, and more favorably disposed to instruction via computer,” (p. 10). These findings were statistically significant and are consistent with the current study.

This study is also consistent with previous research with respect to which learning style groups appear to struggle most with technology. In the current study, AS teachers reported that they had significantly fewer needs, higher stages of adoption, greater degrees of expertise, and higher levels of competency than CS and AR learners. Ester (1994) found that AR learners performed better when an instructional approach was used that did not involve technology. Ross, Drysdale, and Schulz (2001) found that AR learners were most at-risk in computer-related courses based on their GPAs. Ames (2003) found that AR and CR learners were not as interested in computers as a medium for learning new material.

The finding by Ames (2003) that CR learners expressed less interest in using computers as a learning tool. In the current study, CR teachers were found to have significantly higher stages of adoption, software expertise, and technology competencies than AR teachers. Perhaps these two seemingly contradictory findings can be reconciled. Gregorc (1997) asserts that CR learners prefer to learn new
knowledge and skills independently, through experimentation, and at their own pace. CR learners also prefer to work in less structured environments (Gregorc, 1997). Perhaps the reservations that CR learners expressed about using a computer to learn new material relate more to the structure that computer-based learning would entail and less to the concept of technology use in general.

Other findings regarding differences between Gregorc learning style groups have been more subtle, but they are also consistent with the current study. As noted in Chapter 2, Ross and Schulz (1999) studied reactions to a computer-assisted instruction system among learning style groups. They found that AS participants in their study worked longer with the system and utilized a greater number of its features than members of other learning style groups. These results were not statistically significant, but the authors considered them noteworthy.

These prior findings provide insight regarding the appropriate interpretation of the findings of the current study. The fact that the observations noted in the Ross and Schulz (1999) study were discernable, yet not statistically significant, contribute a possible explanation regarding the reason that the most liberal post hoc test was required to detect differences in the current study between groups with respect to the stages of adoption and competency variables. The Fisher LSD also identified differences between more groups on the needs and software expertise variables.

These findings are also consistent with the results of this study, in which AS participants were found to have fewer needs, higher stages of adoption, more software
expertise, and more highly developed technology competencies than members of the CS and/or AR groups. These findings were statistically significant with respect to four of the five variables studied. It is also interesting to note that eight out of the 11 differences identified between the groups in this study involved the AS group. When viewed in light of the results of previous studies, it appears that the AS learning style group may be more capable with respect to computers and technology than members of other groups.

Implications and Recommendations for Future Research

Christa McAulliffe once stated, “I touch the future. I teach.” Without question, highly qualified teachers help students to maximize their potential in ways that have far-reaching implications. Students currently enrolled in elementary school must be prepared to usher in successive waves of innovation in order to keep America competitive and assure its economic future. Increased pressure from foreign manufacturing competition and the current trend to outsource technology jobs formerly performed in the United States illustrate the importance of teaching the next generation to use technology (AEA, 2001; ITAA, 2003). At this point, the record is mixed. Although an estimated $5 billion is spent annually on educational technology, 45% of teachers reported in a recent survey that they used it for instruction less than 15 minutes per week (NCES, 2003; Norris et al., 2003).

Perhaps it is possible that an approach to technology staff development that takes into account the uniqueness of teachers might have a favorable impact on
teaching and learning with technology. The AS group, which accounts for the smallest percentage of teachers in the sample (7.6%), had the fewest technology-related needs, highest stages of adoption, more software expertise, and more developed technology competencies.

The findings of the current study, especially when coupled with the findings of previous research, also suggest that AR and CS learners may struggle more with using technology in instructional settings. Compared to AS teachers, CS and/or AR teachers had significantly lower scores on all four variables studied in the course of this investigation. CR teachers also outperformed AR and/or CS teachers in three areas. This finding has significant implications. As noted in Chapter 3, the CS and AR groups jointly accounted for 67.2% of all teachers in the sample used in the current study. If the results of the current study are generalizable to teachers of grades pre-kindergarten through four, the majority of teaching personnel who are responsible for teaching students about technology may be less adept at performing this function than a much smaller group of their colleagues.

Further research is needed to determine why AS teachers, as noted in several previous studies, appear to be more adept and enthusiastic users of computers than their CS and AR counterparts. Perhaps staff development strategies currently utilized in most school districts more closely match certain learning styles. If further research could find that a match exists between the AS learning style and the most widely employed strategies for teacher technology staff development, perhaps efforts could be
made to structure staff development initiatives to accommodate the learning styles of other groups.

The primary practical implication of these findings may be that if staff development programs currently work well for AS learners (and CR learners, to a lesser degree), accommodations might be identified and utilized that would enhance the effectiveness of technology staff development programs for CS and AR teachers. Mentoring opportunities, for example, might be restructured to reflect these findings. By using the GSD, the Snapshot Survey, and the TECS, veteran teachers with good technology skills could be identified. This practice would provide a pool of technology-savvy teachers who could serve as mentors in the area of instructional technology for those who are new to a given school or the teaching profession. Teachers who have an opportunity to work with a mentor with a complementary learning style might learn technology skills more rapidly.

It is important, however, to place the results of the current study in perspective. The fact that the Fisher LSD, the most liberal of post hoc tests, had to be used to identify eight of the 11 differences between groups -- and all of the differences between the groups on two variables -- suggests that more research is needed before restructuring of technology staff development programs based on the Gregorc learning style model is warranted. The results of this study may reflect, in part, differences in the ability of people with different learning styles to accurately assess their technology proficiency. Perhaps some of the difference between the groups may be attributed to a
predisposition among those who share the AS learning style to more favorably rate their proficiency with technology. In contrast, AR learners may be most critical of their own abilities.

Accordingly, the following seven recommendations have been made for further research regarding the relationship between learning styles, as identified by the GSD, and technology-related attributes of teachers:

1. Explore the reasons that AS (and, to a lesser degree, CR) learners appeared to have significantly fewer needs and significantly higher stages of adoption, degrees of software expertise, and technology competencies than CS and/or AR learners.

2. Administer the assessments utilized in this study along with a series of task-based assessments to determine whether there is a significant difference between the four learning styles with respect to the accuracy of their self-assessments.

3. Determine whether the most frequently used instructional strategies for the technology staff development more favorably match with any given learning style.

4. Replicate this study with an updated list of competencies that more accurately reflect the technology-related tasks that teachers perform during instruction and while completing related tasks. A more rigorous set of
competencies may serve to further highlight the differences between the four learning style groups.

5. Investigate whether there are best practices for technology staff development based on each learning style group.

6. Conduct a study that places participants in treatment groups based on their dominant learning styles. Investigate whether instructional strategies designed for their dominant learning styles have an impact on their mastery of technology-related knowledge and skills.

7. Replicate this study with a group of secondary teachers to determine if there are any differences between teachers in intermediate, middle, and high school settings.

It is hoped that by continuing to investigate the learning styles of teachers, technology staff development can be improved. If staff development strategies can be tailored to meet the needs of the teachers who attend them, perhaps teachers will become more effective in facilitating instruction using instructional technology. If progress in this area can be made, perhaps the time, energy, and funding currently invested in educational technology can begin to pay greater dividends for our students and the citizens who pay the costs associated with educating them.
APPENDIX A

LETTER OF CONSENT TO CONDUCT STUDY IN MANSFIELD ISD
February 6, 2004

Dr. Scott Simpkins  
Chair, Institutional Review Board  
Office of Research Services  
Administration Building 160  
PO BOX 305979  
Denton, TX 76203-5230

Dear Dr. Simpkins:

I have reviewed the research project, "Technology Learning Styles, Skills, and Perceptions Among PK-4 Teachers." The University of North Texas Institutional Review Board confirmation number for the project is 361027235.

Participation by Mansfield ISD teachers of grades PK-4 is authorized.

Sincerely,

[Signature]

Vernon Newsom  
Superintendent of Schools

VNjp
APPENDIX B

USE OF HUMAN SUBJECTS CONSENT FORM
UNIVERSITY OF NORTH TEXAS COMMITTEE FOR
THE PROTECTION OF HUMAN SUBJECTS

RESEARCH CONSENT FORM

Subject Name: 
Date: 

Title of Study: Technology Learning Styles, Skills, and Perceptions Among PK-4 Teachers

Principal Investigator: Doug Brubaker

Co-investigators:

Before agreeing to participate in this research study, it is important that you read and understand the following explanation of the proposed procedures. It describes the procedures, benefits, risks, and discomforts of the study. It also describes your right to withdraw from the study at any time. It is important for you to understand that no guarantees or assurances can be made as to the results of the study.

Purpose of the study and how long it will last:

The purpose of the study is to determine whether there is a relationship between the learning styles of teachers and their technology-related needs, beliefs, levels of adoption, software expertise, and competency.

Description of the study including the procedures to be used:

The Gregorc Style Delineator (GSD) will be administered to assess learning style. The SnapShot survey by Dr. Cathleen Norris and the Technology in Education Competency Survey will be used to assess teachers' technology-related needs, beliefs, levels of adoption, software expertise, and competency.

Description of procedures/elements that may result in discomfort or inconvenience:

The administration of the survey documents may take up to twenty minutes to complete.

Description of the procedures/elements that are associated with foreseeable risks:

No physical or psychological risks are foreseen.

Research Consent Form -Page 1 of 2 Participant's initials
UNIVERSITY OF NORTH TEXAS
RESEARCH CONSENT FORM (Continued)

Benefits to the subjects or others:
The results of this study may help school districts and campuses to design technology
staff development that better meets the needs of the participants. Participants in the study
will receive half of a numbered ticket. After all campuses have been visited, a ticket will
be drawn. The number will be sent to the elementary campus principals to forward to the
members of their staff. The winner will receive a $50.00 gift certificate from Barnes and
Noble.

Confidentiality of research records:
Individual records will be kept confidential. The surveys will be identified using
sequential numbers instead of names or other personally identifiable information. Results
will be reported at the campus and district level and not include personally identifiable
information. The investigator assumes responsibility for the confidentiality of all records
related to the study. Records will be stored in an MISD facility.

Review for protection of participants:
This research study has been reviewed and approved by the UNT Committee for the
Protection of Human Subjects (940) 565-3940.

RESEARCH SUBJECTS' RIGHTS: I have read or have had read to me all of the
above.

Doug Brubaker has explained the study to me and answered all of my questions. I have
been told the risks or discomforts and possible benefits of the study. I have been told of
other choices of treatment available to me.

I understand that I do not have to take part in this study, and my refusal to participate or
to withdraw will involve no penalty or loss of rights or benefits or legal recourse to which
I am entitled. The study personnel may choose to stop my participation at any time.

In case there are problems or questions, I have been told I can call Doug Brubaker at
telephone number 817.561.3850 or Dr. Mark Mortensen, Department of Technology and
Cognition, 940.565.4130.

I understand my rights as a research subject, and I voluntarily consent to participate in
this study. I understand what the study is about and how and why it is being done. I have
been told I will receive a signed copy of this consent form.

_________________________________________  ______________________________________
Signature of Subject                          Date

_____________________________  ____________________________
For the Investigator or Designee:            ____________________________
I certify that I have reviewed the contents of this form with the person signing above, who, in my
opinion, understood the explanation. I have explained the known benefits and risks of the research.

_________________________________________  ____________________________
Signature of Principal Investigator            Date

Research Consent Form -Page 2 of 2           Participant's initials

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APPENDIX C
DIRECTIONS COVER SHEET
Directions

*Please do not open the packet until directions have been reviewed.*

You are being asked to complete a learning styles profile and survey about your technology beliefs and use patterns.

MISD is facing a shortage of funds for the foreseeable future. This study is designed to determine technology-related needs on elementary campuses and investigate whether staff development opportunities can be structured to better meet the needs of teachers based on their learning styles. *(Supply costs for this study are not being paid for with district funds.)*

Once directions for the packet have been reviewed, please complete it. This should take you ten to twenty minutes.

---

Here are a few notes about the packet so that you may refer to them as you complete it:

- The first two pages are a release form. *Please read the release form, ask any questions, and sign, initial, or date all of the highlighted spaces. You will receive a copy of this form.*

- The learning style inventory that we are using is called the Gregorc Style Delineator. You rate words in sets of four based on which word is most like you and which is least like you.

  *On this test, like the TAKS writing test, a "4" is "highest" (most like you) and a "1" is the lowest (least like you.) Rate each set of words from "4" (most like you) to "1" (least like you). The directions on the Gregorc Style Delineator show how to complete it. Please wait to begin until directions have been reviewed.*

- You will be asked about your learning style on question 10 of the demographic information survey. *If you have two or more learning style scores that are the same, please leave question 10 blank.*

---

When you are finished, please:

- Paper clip your papers and place them in the red collection basket.

- Register for the drawing. Please take a ticket and keep half of it. Please place the other half of the ticket in the basket with your initials on it. Once data collection is completed on all campuses, we will have a drawing for one $50.00 and four $25.00 gift certificates from Barnes and Noble. I will send the numbers of the winning tickets to the principals.

- Enjoy some complimentary candy. Please return your pencil, if you borrowed one.

---

Thank you for participating! ★
APPENDIX D

DEMOGRAPHIC INFORMATION QUESTIONNAIRE
Demographic Information

Please take a moment to share the following demographic information. Please bubble in the appropriate box.

Shade Circles Like This—> ●
Not Like This—> X ☑

1. Years of classroom experience.
   O 1. 1-5 years  O 2. 6-10 years  O 3. 11-15 years  O 4. 16-20 years  O 5. 20 or more years

2. Gender
   O 1. Male  O 2. Female

3. Years that you have worked in the Mansfield ISD.
   O 1. 1-5 years  O 2. 6-10 years  O 3. 11-15 years  O 4. 16-20 years  O 5. 20 or more years

4. Teaching Assignment (Please mark only one).
   O 7. Title I  O 8. PE, Music, Spanish or Art

5. How many hours of technology-related instruction did you have in your teacher certification program?
   O 1. 0 hours  O 2. 1-5 hours  O 3. 6-10 hours  O 4. 11-15 hours  O 5. 16-20 hours
   O 6. 20 or more hours

6. If you have worked in another school district, how many hours of technology-related instruction did you have in the last district in which you worked?
   O 1. 0 hours  O 2. 1-5 hours  O 3. 6-10 hours  O 4. 11-15 hours  O 5. 16-20 hours
   O 6. 20 or more hours  O 7. I have only worked in Mansfield ISD.

7. How many hours of technology-related instruction have you had in the MISD?
   O 1. 0 hours  O 2. 1-5 hours  O 3. 6-10 hours  O 4. 11-15 hours  O 5. 16-20 hours
   O 6. 20 or more hours

8. What is your age?
   O 1. 20-25  O 2. 26-30  O 3. 31-35  O 4. 36-40  O 5. 41-45  O 6. 46-50  O 7. 51 or over

9. What is the highest level of education that you have completed?
   O 5. Doctoral degree

10. What was your dominant learning style on the GSD? (Please mark only one).
    O 1. CS  O 2. AS  O 3. AR  O 4. CR
APPENDIX E

SNAPSHOT SURVEY

Reproduced with permission from Dr. Cathleen Norris.
Teachers and Technology: A Snap-Shot Survey

Please take a moment to fill out this short survey. The survey provides a snapshot of how prevalent technology is in education today, and what you, as an educator, believe about the technology. We plan to use this survey to better understand the growth of technology use in the classroom and address needs within our district.

<table>
<thead>
<tr>
<th>For teachers and administrators: What, if anything, do you need to make technology an integral part of your school or classroom’s curricular activities? Please bubble in the appropriate bubble.</th>
<th>Less Urgent</th>
<th>More Urgent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Need more time to learn to use computers and the Internet</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2. Need more time to better incorporate technology into the curriculum.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3. Need more training with technology.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4. Need more training with curriculum and pedagogy that integrate technology.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5. Need access to more computers for my students.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6. Need more access to the Internet.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7. Need more software that is curricular-based.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8. Need more technical support to keep the computers working.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9. Need more resources that illustrate how to integrate technology into the curriculum.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10. Need to be able to try out technology-enhanced curriculum units in my classroom several times before I am comfortable with them.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11. Need more opportunities to work with colleagues to become more proficient.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12. Need more compelling reasons why I should incorporate technology into the classroom.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Please bubble in the bubble that best reflects your belief where SD=Strongly Disagree and SA=Strongly Agree</td>
<td>SD</td>
<td>SA</td>
</tr>
<tr>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>1. I believe that textbooks will be replaced by electronic media within 5 years.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2. I believe that the role of schools will be dramatically changed because of the Internet within 5 years.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>3. I believe that the role of the teacher will be dramatically changed because of the Internet within 5 years.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>4. I believe that I am a better teacher with technology.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>5. I believe that the Internet will help narrow the societal gap between the &quot;haves&quot; and the &quot;have nots&quot;.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>6. If my district offered Internet-based professional development activities, I would use them.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>7. Student time on the Internet is well spent.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>8. Technology can help accommodate different learning styles.</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
**Concern-Based Adoption Model (CBAM)**

**Levels of Use of an Innovation**

Please mark one category that indicates your overall use of information technology.

<table>
<thead>
<tr>
<th>Level 0: Non-use</th>
<th>I have little or no knowledge of information technology in education, no involvement with it, and I am doing nothing toward becoming involved.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1: Orientation</td>
<td>I am seeking or acquiring information about information technology in education.</td>
</tr>
<tr>
<td>Level 2: Preparation</td>
<td>I am preparing for the first use of information technology in education.</td>
</tr>
<tr>
<td>Level 3: Mechanical Use</td>
<td>I focus most effort on the short-term, day-to-day use of information technology with little time for reflection. My effort is primarily directed toward mastering tasks required to use information technology.</td>
</tr>
<tr>
<td>Level 4 A: Routine</td>
<td>I feel comfortable using information technology in education. However, I am putting forth little effort and thought to improve information technology in education or its consequences.</td>
</tr>
<tr>
<td>Level 4 B: Refinement</td>
<td>I vary the use of information technology in education to increase the expected benefits within the classroom. I am working on using information technology to maximize the effects with my students.</td>
</tr>
<tr>
<td>Level 5: Integration</td>
<td>I am combining my own efforts with related activities of other teachers and colleagues to achieve impact in the classroom.</td>
</tr>
<tr>
<td>Level 6: Renewal</td>
<td>I reevaluate the quality of use of information technology in education, seek major modifications of, or alternatives to, present innovation to achieve increased impact, examine new developments in the field, and explore new goals for myself and my school district.</td>
</tr>
<tr>
<td></td>
<td>Assessment of Software Expertise</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td>Please indicate your interest/level of expertise in each package by marking a category according to the scale:</td>
</tr>
<tr>
<td>1</td>
<td>1 = I don't know anything about it.</td>
</tr>
<tr>
<td></td>
<td>2 = I know about it but don't use it.</td>
</tr>
<tr>
<td></td>
<td>3 = I have used it on occasion.</td>
</tr>
<tr>
<td></td>
<td>4 = I use it regularly.</td>
</tr>
<tr>
<td></td>
<td>5 = I use it for instruction on a regular basis.</td>
</tr>
<tr>
<td>1.</td>
<td>Microsoft Office: Word</td>
</tr>
<tr>
<td>2.</td>
<td>Microsoft Office: Excel</td>
</tr>
<tr>
<td>3.</td>
<td>Microsoft Office: PowerPoint</td>
</tr>
<tr>
<td>4.</td>
<td>Microsoft Office: Access</td>
</tr>
<tr>
<td>5.</td>
<td>Inspiration or any other Concept Mapping Software</td>
</tr>
<tr>
<td>6.</td>
<td>Accelerated Reader</td>
</tr>
<tr>
<td>7.</td>
<td>GroupWise</td>
</tr>
<tr>
<td>8.</td>
<td>Creating Web Pages</td>
</tr>
<tr>
<td>9.</td>
<td>Internet</td>
</tr>
<tr>
<td>10.</td>
<td>Aeis-it</td>
</tr>
<tr>
<td>11.</td>
<td>Athena or any other Library Cataloging System</td>
</tr>
<tr>
<td>12.</td>
<td>STAR Office: Text Document</td>
</tr>
<tr>
<td>13.</td>
<td>STAR Office: Spreadsheet</td>
</tr>
<tr>
<td>14.</td>
<td>STAR Office: Presentation</td>
</tr>
<tr>
<td>15.</td>
<td>STAR Office: html</td>
</tr>
<tr>
<td>16.</td>
<td>STAR Office: Drawing</td>
</tr>
</tbody>
</table>

Adapted from original SnapShot survey items developed by and used with the permission of Dr. Cathleen Norris, University of North Texas, and Dr. Elliot Soloway, University of Michigan, and the Texas Center for Education Technology. CBAM Levels of Use are Adapted from Hall & Rutherford (1974). Assessment of Immediate Needs developed by Dr. Rhonda Christensen, Univ. of North Texas and Darlene Griffin, Allen ISD.
APPENDIX F

TECHNOLOGY IN EDUCATION COMPETENCY SURVEY

Reproduced with permission from the

Institute for the Integration of Technology into Teaching and Learning.
# Technology in Education Competency Survey

Please mark the bubble that best reflects your belief where SD=Strongly Disagree, D=Disagree, U=Undecided, A=Agree and SA=Strongly Agree

<table>
<thead>
<tr>
<th></th>
<th>SD</th>
<th>D</th>
<th>U</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel competent using a word processor and graphics to develop lesson plans.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2. I feel competent using email to communicate with colleagues.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>3. I feel competent using the World Wide Web to find educational resources.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>5. I feel competent constructing and implementing project-based learning lessons in which students use a range of information technologies.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>6. I feel competent to help students learn to solve problems, accomplish complex tasks, and use higher-order thinking skills in an information technology environment.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>7. I feel competent in recognizing when a student with special needs may benefit significantly by the use of adaptive technology.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>8. I feel competent about teaching K-4 students age-appropriate information-technology skills and knowledge.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>9. I feel competent working with students in various IT environments (such as standalone and networked computers, on-computer classrooms, labs, etc.)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

REFERENCES


