VOICE INPUT TECHNOLOGY:
LEARNING STYLE AND
ATTITUDE TOWARD ITS USE

by

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(ABSTRACT)

This study was designed to investigate whether learning style and attitudes toward voice input technology were related to performance in using the technology. Three null hypotheses were tested: (a) No differences exist in the performance in dictating a paragraph using voice input for individuals with different learning styles; (b) No differences exist in attitude toward voice input for individuals with different learning styles; and (c) No interaction exists for the performance scores for individuals with different learning styles and different attitudes toward voice input technology. The statistical procedure used to examine the hypotheses was analysis of variance.

Participants were 50 students preparing to become vocational teachers enrolled in vocational education courses at Virginia Tech. Procedures involved having the participants complete three stages. First, they completed the Gregorc Style Delineator (CSD) learning style
instrument. Due to a lack of individuals of one learning style category, abstract sequential (AS), only three learning style categories were used in the study. Second, they completed a background information sheet. Third, they participated in the voice-input training and dictation phase. Each student completed a one-hour session that included training, practice using voice input, and dictating a paragraph. Participants also completed the Attitude Toward Voice Input Scale developed by the researcher. It includes 21 attitude statements, 11 positively worded and 10 negatively worded.

The first hypothesis was not rejected. A student's learning style does not relate to the performance of the student when dictating a paragraph using voice input technology. The second hypothesis was not rejected either. A student's attitude toward voice input technology was not related to learning style. The third hypothesis was also not rejected. A student's learning style, regardless of whether the student had a "high" or "low" attitude toward voice input, was not significantly related to performance in using voice input technology. However, the mean performance scores of individuals with concrete sequential (CS) learning styles with "high" and "low" attitudes did appear to be different. Those with "high" attitudes toward voice input had better performance scores than those with "low" attitudes toward the technology.
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CHAPTER 1

BACKGROUND OF THE PROBLEM

Described in this chapter are the background of the problem, rationale for the study, limitations, definitions of terms, and organization.

The interest in talking to machines is not new. The idea of communicating to machines through speech can be traced back to the 1950s. Researchers with companies such as International Business Machines (IBM) and American Telephone and Telegraph (AT&T) have spent millions of dollars trying to create a computer like the fictional character "HAL," the intelligent computer in the movie "2001." The attempt to actually develop a computer such as HAL has resulted in an on-going struggle for the past 30 years (Bolter, 1984; Certon & Davies, 1989; Davis, 1990; Kurzweil, 1990).

The use of technology in everyday life has increased markedly over the last three decades. This increase is largely due to the implementation of computer technology. With the everyday presence of computers we are moving in the direction of the ability to communicate directly with the computer through speech or voice as a means of data input (McDaniels, 1989; Naisbitt, 1982; Naisbitt & Aburdene, 1990; Toffler, 1990).

Communicating through speech is a natural process and a
natural form of communication. After all, people who are not vocally impaired, and even some who are, have practiced speech communication for years. Our wants, needs, and intentions are expressed through voice communication. Therefore, the logical and most natural process for communicating with the computer is through voice communication (Hyde, 1979; Teja & Gonnella, 1983).

Computers with voice input capability provide one solution to the communication barrier between humans and technology. Speaking to a computer is similar to speaking to someone who is not completely familiar with your language. You must speak slowly and more precisely than normal speech, at least with the present state of voice input technology (Teja, 1981; Teja & Gonnella, 1983; Witten, 1982).

As one speaks to the computer, the computer software system allows the computer to learn speech patterns as well as word pronunciation. Further, the software enables the storing of these words in a file or what is commonly called a voice file—a process called voice (speech) recognition or voice input. Essentially, the software allows the computer to distinguish between pronunciation, inflection, volume, and pitch of a word or utterance (Fry, 1979; Haggblade, 1990; Swanson & Swanson, 1985).

Additionally, the computer software translates speech
sound patterns and converts these sounds into a series of words. At this point, the speech is no longer speech, it becomes written text. For example, for the computer to understand the word "technology," millions of computations must occur. Once the word is recognized the computer must then do further processing to select the proper response to that word from its data base. Moreover, computers today can accept various languages as text including English, Dutch, French, German, Italian, and Spanish (Buckler, 1991; Rabiner & Schafer, 1978; Teja, 1981; Witten, 1982).

Currently, with most computers, there is a minimum amount of training that is required by the person using voice input technology. Though in the case of voice input, it is actually the computer that is trained to recognize speech patterns, not the person (Reedy, 1975; Teja, 1981). Using voice input technology may reduce the need for manual dexterity. As Baker (1984) stated, "just as Darwin hypothesized that people developed spoken rather than gestural language, so as to free up their hands, and be able to communicate in the dark or out of sight" (p. 5).

Voice input technology is applicable for people who need both hands free to operate equipment, including laboratory or factory workers who use voice input for purposes of inventory management and quality control. Although handling simple tasks by voice input would be
desirable most of the time in working environments, operating machinery can be noisy. This machine noise could interfere with the voice input commands and have an effect on the interpretation of the speech patterns. The effect of noise when using voice input is still in the early stages of research (Cordy, 1991; Davenport, 1983; Hollis, 1992; Peacocke & Graf, 1990).

Voice input has served the needs of only specialized fields. Now, voice input has become feasible in less specialized fields. Voice input technology applications are being implemented in a variety of settings including the aviation, health care, telephone, and banking industries, as well as the United States Postal Service (Cordy, 1990; Coursey, 1990). In addition, voice input technology has enabled individuals with various disabilities to perform office tasks. The recently passed Americans With Disabilities Act (ADA) stated "an employer cannot discriminate against qualified applicants and employees on the basis of disability" (ADA, 1992, p. 1). In addition, people who have sustained repetitive strain injuries such as carpal tunnel syndrome as a result of using the keyboard as a means of data input can benefit from voice input technology (ADA, 1992; Noyes & Frankish, 1989; Schwartz & Hammons, 1991).

Before people can take full advantage of the
capabilities of this technology, the current cost of purchasing the hardware and software to operate the equipment must decrease. The cost of purchasing the hardware and software to operate voice input technology has been historically high; however, lower price trends present an opportune future. Assuming the two integral ingredients—time and money—are present, voice input technology will be commonly used as a means of communicating with the computer (Holmes, 1984; Tazelaar, 1991).

As the technology trickles slowly into everyday use, a next question of interest is how vocational educators will adopt voice input into their curriculum. Further, in the 1980s as people were exposed to new and highly stimulating technologies, an interest developed on the part of researchers in examining students' learning styles in relation to their use and acceptance of technology (Adams, 1985).

Now, vocational educators teaching students in vocational programs in the 1990s must be able to help students at varying levels of learning, with various cognitive abilities and various cultural backgrounds. According to Dennis Adams (1985),

"Learning is everyone's concern. Our country's social and economic well-being depends on how well we educate people for a literacy-intensive"
technological world. If computers can assist us in the teaching process then there is good reason to welcome their appearance. (p. 19)

Therefore, vocational educators need to adapt to these changes and utilize the technological capabilities of new equipment (Dunn & Dunn, 1978).

For a number of years, cognitive scientists have been intrigued by the interaction between the learner and a specific learning environment, i.e. new technology. According to Keefe (1979) by assessing one's learning style, educators can begin to diagnose the way students' learn and disseminate information. Additionally, it would be helpful for educators to determine whether or not students' attitudes toward technology are related to their learning styles. Before implementing voice input technology into the classroom, research is needed to examine learning styles and attitudes as they relate to the technology.

For this study, Anthony F. Gregorc's theoretical framework applied via the Gregorc Style Delineator (GSD) was used to examine relationships between learning styles and voice input technology (Gregorc, 1982a). Further, by determining students' attitudes toward voice input, teachers can gain a better sense of how this technology can be implemented into the curriculum. Therefore, an attitude
scale was developed that examined attitudes toward voice input technology.

Rationale for the Study

Voice input technology is a relatively new innovation as applied to commercial and educational use. Administrators employed in educational institutions will most likely take a conservative approach before actually purchasing voice input equipment. Part of the reason for being cautious is due to inconsistent spending that took place in the 1980s. However, in the 1990s, most schools are experiencing budget crunches. Thus, it is important that educators examine new technology and take into account the cost of purchasing equipment and software before implementing it into the classroom.

Specifically, this study determines the link between learning style and performance in using voice input. Teachers who are aware of the potential differences among students as they adapt to voice input can better devise curriculum plans to teach it. Researching the use of this technology before implementing it into the classroom can facilitate the preparation of teachers to teach students, including students with disabilities, to use voice input technology. With the passage of the Americans with Disabilities Act, voice input technology becomes an
attractive means of helping managers and trainers assist people with disabilities to become more productive in the workplace. The research reported here examined three constructs: learning styles, attitudes toward voice input, and performance in using voice input. In this study, the researcher examined whether or not there is (a) a relationship of learning styles to the performance in using voice input, (b) a relationship of learning styles to attitudes toward voice input, and (c) a relationship of learning style along with attitude toward voice input and the performance in using the technology. Findings from this study may be used to help develop instructional strategies for the future.

Purpose of the Study

The purpose of this study was to determine if learning style and attitudes toward voice input technology relate to performance in using the technology. The following null hypotheses were tested:

Hypothesis One. No differences exist in the performance in dictating a paragraph using voice input for individuals with different learning styles.

Hypothesis Two. No differences exist in attitude toward voice input for individuals with different learning styles.
Hypothesis Three. No interaction exists for the performance scores for individuals with different learning styles and different attitudes toward voice input technology.

Limitations

The following limitations applied to the research design and execution of the study:

(1) Financial constraints allowed for use of only one voice input system that was available to the researcher. Therefore, the voice input system chosen for this study was Dragon Dictate from Dragon Systems Incorporated.

(2) Due to the purposive nature and size of the sample, the generalizability of this study was limited. Generalizations to similar groups in vocational education at similar university settings should be made with great caution.

(3) The word processing application software WordPerfect, version 5.1, was used to process input to the screen along with Dragon Dictate. Dragon Dictate can be used with other word processing software as well as with other software applications including spreadsheet, database, and graphic application packages. Therefore, using Dragon Dictate with other software applications may yield different results.

(5) Of the four Gregorc Style Delineator learning styles that were assessed for this study, only three learning
styles were included due to lack of participants with the abstract sequential learning style.

Definitions of Terms

**Attitude Toward Voice Input Scale (ATVIS)** is an attitude scale developed to determine one's feelings or beliefs toward voice input technology. The ATVIS was developed by the researcher and used as an instrument for this study. **Continuous recognition** is a voice input system in which the operator talks naturally, without restrictions or pauses after each spoken word. **Discrete recognition** is a voice input system in which the operator uses an utterance that includes a pause after each spoken word. Each system can understand voice patterns by recognizing a speech pattern which is stored in a data base (voice) file in the memory of the computer. **Gregorc Style Delineator** is a research-based self-analysis instrument. It is designed to help reveal a special set of mental qualities and mediation channels available to you for handling the immediate demands of life (Gregorc, 1982a). There are four mediation channels: concrete random, abstract random, concrete sequential, and abstract sequential. **Learning styles** are distinctive behaviors which serve as indicators of how a person learns from and adapts to the
environment. It also gives clues as to how a person's mind operates (Gregorcić, 1979).

**Performance scale** is the measure of an individual's performance on voice input equipment as evaluated by the researcher.

**Utterance** is a vocal expression or a string of vocal sounds that can be composed of a word, group of words, sound, or phrase that is followed by a pause.

**Voice input** is a form of dictation in which the user communicates with the computer using speech converting an utterance into ASCII codes.

**Organization**

This dissertation is divided into five chapters. Chapter 1 provides an introduction to the problem, rationale for the study, purpose of the study, null hypotheses, and definitions. Chapter 2 consists of review of the literature and theoretical framework for the study. Chapter 3 outlines the research design, methodology, data collection procedures, and statistical analyses of the data. Chapter 4 presents the research findings in regard to the null hypotheses developed from the research questions. Chapter 5 presents a summary, conclusions, discussion, and implications. The reference list, appendices, and vita follow Chapter 5.
CHAPTER 2

REVIEW OF THE LITERATURE

Discussed in this chapter are the complexity of voice input, continuous and discrete recognition, Americans With Disabilities Act, repetitive strain injuries, the complexity of using the keyboard, and Dragon Dictate. In addition, learning style and cognitive style, the theoretical framework of the Gregorc Style Delineator including definitions, and attitude toward voice input are discussed.

In 1952, the first successful voice input system was reported by Davis, Biddulph, and Balashek of Bell Laboratories. This voice input system could recognize ten digits spoken by a single user with 100% accuracy. However, with a different user, only 50% accuracy was reported. The procedure was to have the user speak as clearly as possible into the voice input system while pausing between each digit (Hyde, 1979; Reddy, 1975). Four years later, a voice input system developed at Bell Laboratories was reported to have almost 100% word recognition. This system could also be used with other users and maintain high accuracy, but it had the limitation of requiring the users to modify their voices. During these experimental stages of voice input, the vocabulary could not be increased, and it was impossible to increase the number of users without a significant time period for retraining (Hyde, 1979; Reddy, 1975). A study by
Olson and Belar in 1956 reported 98% accuracy using a machine with a vocabulary of ten monosyllabic words used in a complete sentence by one speaker. Similar research was conducted in 1959 by other researchers, namely Denes in England and Forgie and Forgie at Lincoln Laboratories (Hyde, 1979).

In the 1960s, high speed computers brought about major change in the issues in the field of voice input technology. Some major issues during this decade were the distinction in research between storing voice patterns from utterances by several users and storing voice patterns of different users separately. The degree of variability among different users, the type of pattern stored, and the way in which different patterns were combined between the similar utterances by different users were examined. Additional research was conducted at the University of Illinois, Stanford University, RCA, MIT, and IBM regarding the same subject area. But the limited funding available for voice input research left three remaining questions: (1) Would voice input systems ever be economically feasible? (2) Would there be any restrictions on voice input systems? (3) Could systems be extended and extrapolated toward more sophisticated computer systems (Hyde, 1979; Reddy, 1975)?
The Complexity of Voice Input

The complexity of voice input research confronted questions of whether speech is continuous or discrete. Other factors such as the restrictions of vocabulary size and the accuracy with which words could be recognized were also issues researchers considered. Some common constraints in voice input systems include duration of the computer training, language of communication, number of users, level of breathing, and room reverberation or the quietness of the environment. Research in these areas is currently being explored (Reddy, 1979; Witten, 1980).

When using voice input technology there is some training that is required for each individual. In the training session, the speaker is training the software program to recognize one's voice. Training usually consists of saying a small sample of words into the microphone of the computer. These spoken words are stored so the computer can match these words in the database's speech file (Reddy, 1979; Witten, 1980).

Voice input became popular in the 1960s and 1970s despite three limitations. First was the performance of the equipment. An unacceptable error rate for real-life situations existed. That is, would business and industry be willing to adopt this new technology given the slow performance and inaccuracy of the equipment? Second was
insufficient understanding of the human problems. The question of whether or not voice input was a substitute for the keyboard existed. That is, voice input was not a practical way to input data. Third was the cost of the equipment. As long as speech recognition systems continued to cost as much as $50,000 to $100,000, their use was limited (Holmes, 1984; Reedy, 1979).

Continuous and Discrete Recognition

Voice input technology is presently heading in two directions: continuous and discrete recognition. The first direction involves continuing to increase the vocabulary size of words spoken in isolation or discrete voice input systems. When speaking to the computer there must be an utterance followed by a pause before saying each word (e.g., school <pause> work <pause>). The time between utterances is presently about one-quarter (1/4) of a second. The other direction is continuous voice input systems. This is considered natural speech or spontaneous speech—speaking naturally. It does not require a pause after each spoken word. Technological developments in this area address coping with real-life conditions such as ambient noise, reverberation, and changing speaking habits. The problems of overcoming the noise level may be integral to the voice
input process (Lee, Hauptmann, & Rudnick, 1990; McGilchrist, 1990; Reddy, 1979). Presently, the main objective of voice input research is to find the right practical applications for its use. Researchers must show that voice input systems can handle quantities of data quickly and reliably. Only when researchers can adopt voice input technology economically and effectively and present it as an attractive alternative to the keyboard can voice technology become a dominant means of input. "Perhaps right now speech recognition is an art rather than a science; the artist doesn't want to wait for a compilation of results, he needs to be able to see now what he is doing" (Reddy, 1979, p. 86). Regardless of whether the system is discrete or continuous, the consensus is that voice input technology be tested and applied to everyday use (Bradford, 1991; Lee, Hauptmann & Rudnick, 1990; McGilchrist, 1990; Reddy, 1979).

Americans With Disabilities Act

Recently, the federal government passed the Americans With Disabilities Act that became effective in July, 1992. As noted in Chapter 1, "an employer cannot discriminate against qualified applicants and employers on the basis of disability" (ADA, 1992, p. 1). A qualified applicant with a disability is defined as:
An individual with a disability who meets the skill, experience, education, and other job-related requirements of a position held or desired, and who, with or without reasonable accommodation, can perform the essential functions of a job. (ADA, 1992, p. 2)

The Americans With Disabilities Act defines a person with a disability as, "an individual who has a physical or mental impairment that substantially limits one or more of his/her major life activities; has a record of such an impairment or; is regarded as having such an impairment" (ADA 1992, p. 3). Therefore, with the presence of voice input technology, individuals who are unable to use their hands because of physical disabilities or individuals who have sustained hand or arm injuries will be able to compete in the job market.

Repetitive Strain Injuries. Repetitive strain injuries (RSI) are becoming the fastest growing among occupational hazards in the workplace. RSI are often caused by working in environments where the work is repetitious and often done in uncomfortable working conditions (Guidotti, 1992; Ubois, 1992). With the proper training on voice input equipment, however, individuals who have sustained RSI injuries will be able to re-enter the work force.

A common workplace-related RSI injury is carpal tunnel syndrome (CTS). CTS is an afflictation or condition caused
by continual and often rapid typing resulting in a numbness or tingling feeling in the fingers and wrists. Occupational related CTS has caused an increase in the costs of workers' compensation and absenteeism in many businesses (Franklin, Haug, Heyer, Checkoway, & Peck, 1991; Harvey, 1991). As noted by Franklin et al. (1991), the Washington State Department of Labor and Industries collected data on workers' compensation claims and reported that an increase from 1.78 per 1000 full-time work equivalents in 1984, to 2.0 per 1000 in 1988 was due primarily to RSI injuries. In addition, lawsuits against firms such as IBM and Apple Computer have been filed in regards to defective keyboard design (Reske, 1992). Therefore, the transition from using the keyboard to using voice input would likely result in decreasing the number of lawsuits and workers' compensation claims associated with hand-wrist motion.

The Complexity of Using the Keyboard. Voice input technology is viewed by many as the next generation in computer interface technology. As developers of voice input systems continue to increase, the data input speed, the vocabulary size, and the complexity of grammar, the keyboard will be looked at as a less attractive means of input. However, "technical innovations are not always diffused and adopted rapidly, even when the innovation has obvious and proven advantages" (Rogers, 1983, p. 243).
In the past, many researchers experimented with trying to restructure the awkward design of the standard keyboard. Historically, there are two primary shortcomings of the standard keyboard: (1) uneven load and (2) frequent use of the third row. For most people in our right handed culture, the left hand has approximately 9/10 the speed and the strength of the right hand. According to Russon and Wanous (1960), the current keystrokes of the left hand are used roughly 57% of the time and the right hand is used 43%. For example, the little finger of the left hand controls 8.2% of the stroking while the stronger right hand second finger only handles 7.2% (Russon & Wanous, 1960; West, 1983). Thus, many researchers have explored new ways to restructure the standard keyboard as a means of data input.

Many attempts have been made to redesign the keyboard as a form of data entry. The Ternary keyboard is an example of one of the latest attempts to restructure the keyboard. Developed by Lawrence W. Langley of VATELL Corporation, this newly designed keyboard requires psychomotor skills to move or "rock" the keys forward and backward. The keyboard consists of four keys on each side and does require the use of both hands for use (Kroemer, 1992). Another attempt to challenge the keyboard was the Optical Character Recognition (OCR) scanner. The scanner, unlike the Ternary keyboard, did not resemble the shape of the traditional keyboard. The
OCR scanner was originally developed to become a form of input with computers in the early 1960s, actually before the manufacturing of computer keyboards. However, this technology did not evolve as the primary source of input, partially due to lack of money and research (Kroemer, 1992).

Touch screen monitors were another attempt to challenge the keyboard. This product was supposed to be a panacea for "keyboard phobia." More recently, other devices such as the "mouse," which first became popular with the Apple Machintosh computers, and pen-based computers (a form of handwritten input) have both become accepted as a supplement or accessory to the keyboard (Cetron & Davies, 1989; Kroemer, 1992).

**Dragon Dictate.** One company that serves the needs of workers with disabilities and people who cannot use the keyboard as a result of repetitive motion injuries is Dragon Systems Incorporated. The people of Dragon Systems have created voice input software known as Dragon Dictate. This software can recognize sounds or words less than 5 seconds long and words that are separated by a quarter-second pause between each sound or spoken word. The system requires a minimum of a 80386 processing chip accompanied with 640 Kilobytes (K) of standard Random Access Memory (RAM) and extended memory of 8 Megabytes (M) of RAM. Other accessories include a speech board, microphone, and
compatible MS-DOS software. Dragon Dictate is a discrete voice input system with a noticeably larger vocabulary than a continuous voice input system. Presently, Dragon's dictionary has the capacity to store 30,000 words and incorporates an 80,000 word dictionary (Gallant, 1990; Lieberman, 1990; Olsen, 1991).

Dragon Dictate can adapt with training to a user's speaking style. Dragon Dictate also allows the user to build macros. The macro building capabilities of Dragon Dictate allow the user to enter large blocks of text by speaking short phrases. Typically, Dragon Dictate creates text at a rate of 35 to 50 words per minute (Gallant, 1990; Lieberman, 1990; Olsen, 1991).

As developers of voice input systems such as Dragon Dictate continue to explore the capabilities of voice input technology, the industry tends to be divided between discrete and continuous voice input systems. Dragon Systems is continuing to research discrete systems whereas other developers such as Kurzweil Applied Intelligence continue to pursue continuous systems (Gallant, 1990; Lieberman, 1990; Olsen, 1991). Regardless of the system used, the aim of voice input technology is to focus on its practical use.

Uses of Voice Input

As noted in Chapter 1, voice input technology is
becoming less specialized and more practical to serve and meet the needs of a variety of industries. The U.S. market for voice recognition hardware and software is expected to exceed $100 million by 1993 (Schwartz & Hammons, 1992). Described below are some of the uses in which business and industry are currently experimenting with voice input technology.

The telephone industry is increasingly adopting voice input technology. American Telephone and Telegraph (AT&T) has developed voice input technology that recognizes and responds to human voice. AT&T plans to adopt voice input technology nationwide to automate long-distance calls that are currently handled by operators. Although this proposed platform ensures that the consumer will benefit from this new technology, the number of employees of AT&T is expected to decline. AT&T plans to eliminate approximately one-third of its 18,000 operators. In addition, 200 to 400 management positions will be eliminated as part of a restructuring strategy. However, AT&T plans to create new jobs related to the new voice input technology and will encourage present operators to apply. This is the latest attempt in trying to increase operator productivity and speed calling ("Voice recognition," 1992).

Voice input technology is being used in aviation. Motorola Incorporated has entered into a $10 million three-
year contract with Contraves USA-SSI for their voice responsive system--USA-SSI's Trainer for Air Traffic Control and Radar (STAR) system. STAR is an interactive training system intended to be used by air traffic controllers. This scenario-based training system is comprised of computer-based instruction for teaching facts, rules, and procedures required by air traffic controllers ("Voice responsive training," 1992).

The Federal Aviation Administration (FAA) has signed a contract with IBM to adopt voice input technology. This $4.4 billion contract consists of a new voice input computer system intended to be used at FAA en route centers, terminals, and airport towers. This system, Tower Control Computer Complexes (TCCC) will be used as an additional input device with the keyboard. Moreover, the TCCC system is one of five systems being developed by IBM (Marsan, 1991).

Voice input systems are being used in the health care profession. Health care administrators can immediately report data by dictating notes, which can be made readily assessable to insurance companies and government agencies (Crockett, 1991; Lindquist, 1991).

The United States Postal Service is considering adopting voice input technology. The purpose is to allow postal sorters to free up their hands by simply speaking the
address out loud and having a computer display the zip code (Lindquist, 1991).

Applications of voice input technology are becoming more readily available in offices, homes, and factories. Researchers are optimistic that voice technology will be used in areas such as making airline reservations or stock trading. Brokerage firms are using voice input systems for bond and stock trading (Crockett, 1991; LaPlante, 1990; Schwartz & Hammons, 1991).

These are some of the more noticeable commercial advances in voice input technology. Therefore, it is important to examine this technology at the academic level to gather information on the acceptance and usage of this technology. From this information, school systems will be better prepared to implement this technology in their educational programs.

Learning Style and Cognitive Style

The terms learning style and cognitive style have been used interchangeably in the literature. There are, however, distinct differences. Research literature concerning learning styles can be traced as far back as 1892. Then, researchers were interested in studying the relationship between memory and teaching methods. As research in learning styles widened, so did the discrepancies between
researchers' views. One of the major criticisms in the 1930s and 1940s was the lack of sensitivity of instruments to differences among populations. Moreover, researchers were interested in determining one particular learning style that would increase learning or retention. The vast majority of the research involving learning styles focused on studying personality-related characteristics in the cognitive style arena (Keefe, 1979).

Many researchers and educators have developed a variety of learning style assessment instruments. Some of the more popular instruments that were developed in the 1960s, 1970s, and 1980s were the Learning Strategies Questionnaire (Kagan, Moss, & Sigel, 1963), the Learning Style Inventory (Kolb, 1971), the Group Embedded Figures test (Witkin, Oltman, Raskin, & Karp, 1971), the Learning Style Inventory (Dunn & Dunn, 1978), and the Gregorc Style Delineator (Gregorc, 1982a). Although all these learning style instruments are acceptable for determining learning style, for this study, the researcher chose the Gregorc Style Delineator because it is more up to date and is more appropriate to use with the variables used in this study (Gregorc, 1982a).

The term "cognitive style" is defined as the way one processes information or learns information through perceiving, thinking, problem solving, and remembering (Messick & Associates, 1976). The term cognitive style, as
labeled by Allport in 1939, was associated more with distinguishing distinctive personality types.

In the 1970s, researchers considered other cognitive styles, such as memory or retention styles and risk taking versus cautiousness. Since that time, researchers have branched out from the cognitive style and developed an interest in learning styles (Keefe, 1979).

**Theoretical Framework of the Gregorc Style Delineator**

The Transaction Ability Inventory (TAI) or what is similarly known today as the Gregorc Style Delineator (GSD) is based on a mediation theory known as the ORGANON System. That is, that the "human mind has channels through which it receives and expresses information most efficiently and effectively" (Gregorc, 1982b, p. 5).

In 1974, Anthony Gregorc and colleagues conducted a study which included 20 males and females varying in ages from 13 to 65 years old. The researchers were curious about learning behaviors of each participant in different situations. They labeled each behavior in concrete, tangible, and sociocultural terms.

In addition, the researchers were interested in observing different techniques of how students took notes in class and how students studied (Gregorc, 1984). However, prior to selecting the participants for the study, Gregorc
noted the following criteria:

(1) They were "successful" learners who demonstrated clear-cut consistent learning behaviors.

(2) They were able to discern and articulate their feelings about the ease or difficulty with which they performed certain learning activities.

(3) They were willing to be observed, to provide protocol materials, and to be interviewed with open-ended questions in order to collect perceptions. Anonymity was assured. (pp. 51-52)

In addition, Gregorc and his colleagues were interested in keeping track of each participant's performance and behaviors not only in the classroom but also outside the classroom. From this, they assessed additional criteria:

(4) The cognitive subjective perspective of the individual who was behaving.

(5) The individual's feelings prior to, during, and subsequent to the behavior. (pp. 51-52)

Their methods of collecting data included: observation notes, video and audio taped interviews, written protocols, and personal journals of each individual. From the collection of data, Gregorc began to develop themes. Moreover, these themes were closely related to the students' behaviors. For example,

Learners who viewed time as discrete units
expected classes to start on time and end on time whereas learners who viewed time as eternal were not concerned with deadlines or strict punctuality. This led to the hypothesis that common themes form an invisible abstract system of thought [italics added] or mind set [italics added]. These themes appear to guide decisions which manifest concretely in specific mannerisms called style [italics added]. (pp. 51-52)

Results of the study indicated that learning style patterns can be learned or adopted. Moreover, the researchers derived that mind sets come from deeper driving forces that arise from a deeper psychological base: space, time, mental processing, and relationships (Gregorc, 1984).

Gregorc (1984) noted that:

The use of the dual aspects of each of the four driving forces indicated that we, as human beings, are not abstract or concrete. Nor are we sequential or random. We use both sets of qualities in varying degrees. The mind is apparently capable of utilizing and reconciling opposites which permits us to deal with multiple realities. (p. 53)

Another study conducted by Gregorc (1979) examined mental preference and teaching style with a sample of 100 participants. Results of the study showed that students who do not match the style of the teacher tend to find it harder
to learn the same material than other students who do match the style of the teacher.

The GSD is a self-testing or self-analyzing instrument that can determine a person's perceptual and ordering preferences. There are four distinct patterns of style that Gregorc identifies in the GSD: concrete sequential (CS), abstract sequential (AS), abstract random (AR), and concrete random (CR).

Gregorc (1982a) defined each learning style as follows:

**Concrete Sequential.** The concrete sequential individual is product-oriented, not person-oriented, a judge, or a practical dreamer. He or she is concerned with the practical, rather than considering himself or herself lively, rational, or perceptive.

**Abstract Sequential.** The abstract sequential individual is concerned with multi-solutions; and he or she is concerned with quality rather than being solid, nonjudgmental, or insightful; and thinks of himself or herself more as a judge than a practical dreamer, or one who is person-oriented or product-oriented. The abstract sequential individual sees himself or herself as rational rather than practical, lively, or perceptive.

**Abstract Random.** The abstract random individual prefers to be thought of as colorful rather than a perfectionist, a researcher, or a risk-taker; and attuned, not ordered, in search or proof, or innovative; and nonjudgmental over solid, insightful, or concerned with quality. He or she is person-oriented rather than product-oriented, a practical dreamer, or a judge; and lively, not perceptive, practical, or rational.

**Concrete Random.** The concrete random individual is concerned with multi-solutions, not proof, being attuned, or ordered; innovative rather than referential, empathic, or realistic; and insightful, not solid, nonjudgmental, or concerned with quality.
The concrete random individual sees himself or herself as a practical dreamer, not a judge, or being person or product-oriented; and perceptive rather than rational, lively, or practical. (pp. 10-11)

The preferred time frame of taking GSD instrument is three minutes. During this time, an individual must react to first impressions as well as deep, inner feelings. Gregorc (1984) noted that this tapped the unconsciousness of the individual's first impression. The author also noted that by moving as quickly as possible through the words, this would best represent their natural response. Further, there would be no right or wrong answer.

After completing the GSD, individuals are asked to score their results. According to Gregorc (1984), a dominant learning style or "mediation" channel would fall in the range between 27 and 40 points, the intermediate or moderate range would fall between 16 and 26, and low range would fall between 10 and 15.

Attributes of the Four Learning Styles

Gregorc (1982a) defined the attributes of the four learning styles as follows:

Concrete Sequential Attributes. The concrete sequential individual is most comfortable when the "system" tangibly rewards the hard work of its loyal employees. He or she prefers meetings which are structured by an agenda, efficiently run, and which require a minimum of discussion. When the people around him or her are concerned with details and the preciseness of their work, the concrete sequential
person feels at home. He or she prefers to attack a problem straight on rather than exploring all the possible ramifications. When a work area, classroom, or living room is free from distractions, the concrete sequential person feels he or she is most able to concentrate and relax. The concrete sequential individual characterizes himself or herself as ordered and objective. The concrete sequential individual is usually uncomfortable with personal things such as photographs, posters, and meaningful mementoes in his or her classroom, office, or home. He or she prefers not to use metaphors, poetic license, and stories to get ideas across. He or she avoids wearing colorful clothing. And, he or she is unlikely to relax like a psychic sponge, absorbing ideas, information, vibrations, and impressions. Discomfort is often experienced by the concrete sequential person when he or she is among people who show swings of mood from great joy to sadness, and when people around him or her change their minds and stop doing something in order to do something else when their moods change. The concrete sequential individual does not see himself or herself as person-oriented, colorful, or particularly aware of the people around him or her. He or she would not characterize himself or herself as having or exhibiting empathy very often, or as being particularly sensitive or attuned. The concrete sequential is not comfortable being characterized as aesthetic or non-judgmental.

Abstract Sequential Attributes. The abstract sequential individual prefers to take the time to study and discuss an issue rationally by gathering data, checking correlations, and weighing various viewpoints. He or she is most comfortable when meetings are held to discuss serious philosophical and substantive issues rather than the sharing of administrative detail or faculty concerns. Environments where intellect and academic excellence are appreciated and strongly reinforced are preferred, along with circumstances when scholars in the field are appreciated. The abstract sequential individual is most comfortable when he or she can review, compare, or synthesize the thoughts and writings of others and build upon them. The abstract sequential individual is likely to characterize himself or herself as evaluative, logical, and rational. The abstract sequential individual is usually uncomfortable in the presence of adventurous people who are concerned with solving real problems, or when
authorities permit the presentation of solutions to problems without having to document the process or steps. Discomfort is experienced when he or she is around an individual who is a practical dreamer, or someone who uses humor to show how fragile truths are. He or she is uncomfortable working with individuals who are concerned with using and trying multiple processes, methods, and approaches to solving application problems, or with people who get the gist of what is said without encountering exact statements and all the details. The abstract sequential individual experiences discomfort when he or she is encouraged to experiment with intuitive flashes or hunches. The sequential individual would not characterize himself or herself as insightful, a trouble shooter, intuitive, or as a practical dreamer. He or she does not see himself or herself as innovative or likely to be working with multi-solutions to problems.

Abstract Random Attributes. The abstract random individual is most comfortable when he or she knows that it is okay to change his or her mind and stop doing something in order to do something else when his or her mood changes. He or she prefers meetings with a flexible agenda where people are free to talk about things that are of interest to them. The abstract random individual is most likely to characterize himself or herself as lively and spontaneous. Circumstances demanding reaching goals by steadily pacing with a definite plan and objective are often uncomfortable for the abstract random individual. He or she can face difficulty in dealing with practical matters which make a difference in everyday life, when thoroughness is appreciated, or in using methods and materials that have been tested and are known to work. Discomfort may be experienced when people get to the point quickly and clearly without excess verbiage, or when the people around him or her are concerned with the details and preciseness of their work. The abstract random individual would not characterize himself or herself as ordered, realistic, or careful with detail. He or she is not a perfectionist and not product-oriented. He or she prefers not to be thought of as persistent or solid.

Concrete Random Attributes. The concrete random individual is most comfortable when he or she can reduce his or her attention to facts and details and,
then try to discover relationships which tie facts together. He or she prefers to have three or four irons in the fire at the same time and still be considered a producer who gets things done creatively. The concrete random individual is likely to characterize himself or herself as perceptive, experimenting, and risk-taking. The concrete random is uncomfortable when people address problems rationally, logically, and from a theoretical base, or when in the presence of academically oriented, intellectually stimulating people. He or she may experience discomfort in the presence of people who use the English language fully and with precision and grace, or when people at a meeting or class have read and digested the materials prior to the session and continually refer to them. He or she is uncomfortable with people who use clear logic and stay away from injecting their subjective feelings into a topic. The concrete random individual is not likely to characterize himself or herself as referential, or analytical, or as a judge or researcher, or as highly concerned with ideas or statistical proof. (Gregorc, 1982b, pp. 13-15)

Studies That Used the Gregorc Style Delineator

In previous studies that used the Gregorc Style Delineator, there has been no study that examined the effect of learning style and voice input. However, there are some studies that proved to be of interest to the researcher.

In one study, Lundstrom and Martin (1986) investigated the interaction between method of instruction and learning style using 132 educational psychology students. He found that there was no significant interaction between the method of instruction and preferred learning style.

When Helgesen (1986) studied whether relationships existed between preferred learning styles and students'
ratings of their teacher, he found a significant relationship. Moreover, it was reported that a relationship existed between teachers' and their students' learning preferences. Students who rated their teachers high had similar learning styles to their teachers.

Finally, a study conducted by Davenport (1986) at the University of Georgia examined whether age and gender were related to preferred learning style among elderhostel participants. There was no significant relationship between age and preferred learning style. However, there was a significant relationship to gender and learning style. Males scored higher in the abstract sequential learning style domain than females, whereas females scored higher in the abstract random than males. However, both males and females scored highest in the concrete sequential domain. The results in this study were used in initiating a new curriculum for elderhostel participants.

The Gregorc Style Delineator as an Ipsative Instrument

The Gregorc Style Delineator (GSD) is a self-test or self-analysis instrument— it is an ipsative measurement instrument. Hicks (1970) defined ipsative measurement: "any score matrix is said to be ipsative when the sum of the scores obtained over the attributes measured for each respondent is constant" (p. 169). An ipsative test is a
test "yielding multiple scores, in which the sum of scores for all individuals is the same, so that an individual who is high on some scales of the test must be low on the others" (Thorndike & Hagen, 1969, pp. 648-650).

Characteristics that apply to ipsative tests are as follow:

(1) The sums of the columns, or rows, of an ipsative covariance matrix must equal zero.

(2) In the case where ipsative variances are equal, the sums of the columns, or rows, of the ipsative intercorrelation matrices are equal to zero.

(3) When ipsative variances are equal, the average intercorrelation will take its limiting value, \(-1/(m-1)\), where \(m\) is the number of variables in the ipsative test.

(4) The sum of the covariance terms obtained between a specified criterion and a set of ipsative scores is zero.

(5) When ipsative variances are equal, the sum of the ipsative validity coefficients is zero. (Hicks, 1970, p. 172)

Ipsative scales have a "forced-choice item" format. That is, a person must make a decision between the alternatives (Gordon, 1951). For every positive or plus score, there must be a negative or minus score. "The pattern of choices
and rejections becomes, then, a pattern of relative preference and the base line is the individual himself (sic)" (Thorndike & Hagen, 1969, p. 394). Other authors who support forced-choice are Edwards (1957) and Krug (1958). However, there are people who disagree with the ipsative scale. Clarke and Merenda (1963) stated that the forced-choice method "biases the response set, thereby leading to a distortion in the personality profiles" (p. 168). Davis and Chissom (1981) concurred after they had studied the effects of factor analyzing ipsative data. They concluded that the factors extracted were either underestimated or overestimated. In addition, "such an analysis will tend to create fictitious bipolar factors, lose some 'real' factors, or distort the structure of factors which are, in part, accurately identified" (p. 647). Davis and Chissom (1981) noted that non-correlational techniques should be used when analyzing ipsative data. Flaitz cited from Horn and Cattell (1965) that "correlating and factoring of such measurements may be quite senseless if their ipsative properties are recognized" (p. 270).

In defense of the forced-choice method, Cronbach (1970) refuted Clarke and Merenda (1963) (previously mentioned) by stating that "the forced-choice test is ordinarily a purer measure of the criterion relevant qualities in the test because irrelevant verbal responses habits are eliminated"
(p.542). Cronbach (1970) noted that forced-choice is a measure of controlling for bias.

Further, the GSD was measured in regards to internal consistency and stability and by test-retest correlation. The GSD is a valid and reliable instrument for assessing students' learning styles (Gregorc, 1982a). In regard to the review of literature of the ipsative effects on scaling, there are precautions when reporting and interpreting the ipsative data; however, there is more evidence that supports the validity and reliability of the ipsative instrument. Results of the testing for reliability are reported in Chapter 3.

Atitudes Toward Voice Input

Atitudes were first studied in 1918 by Thomas and Znaniecki (Triandis, 1971). They defined social psychology as the study of attitudes. Allport (1935) defined attitude as: "a mental and neutral state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related" (p. 810).

In other words, attitudes are evaluative beliefs, our likes and dislikes. People develop attitudes for many reasons such as aversion to situations and likes and dislikes of people, objects, our environment, and computers (Bem, 1970).
During the past four decades, our society has become more dependent upon computers. In the early 1950s, attitudes toward this new technology ranged from credulous to suspicious (Mathews & Wolf, 1983). In the 1980s, researchers became interested in attitudes toward computers (Mathews & Wolf, 1983) and how to measure the effects of computer technology on its users. More specifically, the increasing use of computers in our school systems was evidence of the new technological information society (as mentioned in Chapter 1).

Attitude scales became a popular item in the 1980s. Loyd and Gressard (1984) suggested that attitudes toward computers and attitudes toward learning about computers may play a role in determining the success or failure of new computer programs. The authors devised an instrument that would measure attitudes (1) toward computers and (2) toward learning about computers as well as assisting in evaluating the implementation of curriculum changes. Further, the authors developed what was known as the Computer Attitude Scale. The Computer Attitude Scale consisted of a 30-item Likert-type instrument that contained statements regarding three main types of attitudes: (1) anxiety or fear of computers; (2) liking of computers or enjoying working with computers; and (3) confidence in ability to use or learn about computers. Each of the subscales had coefficient
alpha reliabilities of $r = .86$ or higher. The subjects used for Loyd and Gressard's (1984) study were 155 students enrolled in grades 8 through 12 who participated in a computer-based program. Ages in this experiment ranged from 13 to 18 and there were 51 male students and 104 female students.

The expansion of computers in our school systems has created many opportunities for students to become familiar with computers and their use. As students become familiar with using computers, it is important to examine their attitudes toward the technology. Consequently, in this study, the researcher is interested in attitudes toward voice input. Because voice input technology is becoming more widely used, a scale is needed to determine how people react to voice input. The instrument developed in this study was a 21-item Likert-type scale that measured attitudes toward voice input. To develop the attitude statements a for this scale, a focus group was used as the method of gathering these statements. The focus group was comprised of nine students enrolled in a vocational education course at Virginia Tech.

Focus groups usually consist of 8 to 12 participants and are designed to discuss a specific topic (Krueger, 1988; Morgan, 1988). In addition, focus groups are an inexpensive way to collect in-depth qualitative data (Krueger, 1988;
Morgan, 1988). The focus group technique began in sociology, but has been used by marketing research personnel for a number of years. Thus, social science researchers have borrowed the focus group technique and applied this method to many issues (Erkut & Fields, 1987; Krueger, 1988; Morgan, 1988). In establishing valid construction of the ATVIS, a panel of experts was assembled to eliminate the imperfections in the first draft of the scale. The scale was then pilot tested on individuals who were similar to the participants in the study. Outcomes of the ATVIS for reliability and validity are reported in Chapter 3, and the ATVIS appears in Appendix A.

Summary

Voice input systems are presently in their fourth generation. The first digitized voice systems required a great amount of user training. Presently, voice input systems are available that allow speaking 35 to 50 words-per-minute with minimal training.

Voice input technology is becoming more commonly used in business and industry. Assuming the two integral ingredients of time and money are present, school systems will soon adopt the technology for classroom use. Students can then be given the opportunities to use and learn this technology. But, before implementing voice input into the
curriculum, research is needed to measure attitudes and learning styles as they relate to use of the technology. Once teachers and instructional designers become aware of the problems and advantages of voice input, they can evaluate and implement instructional strategies for including voice input technology in the curriculum.
CHAPTER 3

RESEARCH METHODOLOGY

Described in this chapter are the research design, participant selection process, training procedures, data collection, and data analysis.

Research Design

As indicated in Chapter 1, the purpose of the study was to determine if learning style relates to performance in using voice input technology and how attitudes toward the technology relate to performance in its use. The following null hypotheses were tested.

Hypothesis One. No differences exist in the performance in dictating a paragraph using voice input for individuals with different learning styles.

Hypothesis Two. No differences exist in attitude toward voice input for individuals with different learning styles.

Hypothesis Three. No interaction exists for the performance scores for individuals with different learning styles and different attitudes toward voice input technology.

Description of Participants

Vocational educators are continually confronted with
how to best use new technologies and how to implement instructional strategies for their curriculum. In this study, students preparing to become vocational teachers enrolled in vocational education methodology, curriculum development, and related courses at Virginia Tech were selected to participate in the study. Of the 91 students enrolled in these classes, 50 students were selected for the voice input phase of the study. However, all 91 students completed the Gregorc Style Delineator (GSD) and the background information sheet that accompanied the GSD as shown in Appendix B.

As noted in Chapter 2, Gregorc (1982a) categorized a dominant learning style on his instrument as ranging between 27 and 40 points, intermediate ranging between 16 and 26, and low ranging between 10 and 15 points. In this study, the researcher was interested in locating participants with dominant learning styles in each of the four categories. A dominant learning style consisted of a differential of one point. That is, if a student scored concrete sequential (CS) = 27, concrete random (CR) = 25, abstract sequential (AS) = 23, and abstract random (AR) = 25 the dominant learning style would be Concrete Sequential. Another possible dominant score could be CS = 30, CR = 29, AS = 22, and AR = 11. In this example, CS would again be the dominant learning style. However, if a student scored CS = 43
28, CR = 28, AS = 22, and AR = 12, no one dominant learning style existed. This student who had more than one dominant learning style was not selected to participate in the study. In addition, students who did not score 27 or higher on any one of the four learning style categories were not selected as one of the 50 participants for the voice input phase of the study.

The Gregorc Style Delineator Instrument

The Gregorc Style Delineator is an ipsative instrument and is composed of four learning style categories: concrete random (CR), abstract random (AR), concrete sequential (CS), and abstract sequential (AS). The reliability of the GSD was determined in two ways: internal consistency and stability. Kuder-Richardson Formula 20 with multi-point items was used for internal consistency and the Pearson Product Moment ρ for stability and reliability over time. The results of test-retest administration on the instrument given to the same group on two separate occasions indicate that the Gregorc instrument is reliable. The GSD was administered to 110 adults with the time frame between administering each test ranging from six hours to eight weeks. Outcomes were as follows:
Standardized Alphas (r)

<table>
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<tr>
<th>Administration</th>
<th>1st</th>
<th>2nd</th>
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<tr>
<td>Concrete Random</td>
<td>.91</td>
<td>.91</td>
<td>.87</td>
</tr>
<tr>
<td>Abstract Random</td>
<td>.93</td>
<td>.92</td>
<td>.88</td>
</tr>
<tr>
<td>Concrete Sequential</td>
<td>.92</td>
<td>.92</td>
<td>.85</td>
</tr>
<tr>
<td>Abstract Sequential</td>
<td>.89</td>
<td>.92</td>
<td>.87</td>
</tr>
</tbody>
</table>

In another study, Gregorc (1982b) reported construct validity in administering the GSD while interviewing 475 individuals. Each participant was presented with the classification of the GSD that best described the individual's learning style. Then, Gregorc asked each individual who completed the instrument to identify to what extent the individual agreed with the learning style description. The results from the study showed about 31% strongly agreed with the description, 58% agreed, 10% were not sure, and 1% disagreed. Therefore, the majority found the Gregorc description to match their learning style attributes accurately. For this study, the reliability and validity of the GSD was not established for the 50 voice input participants.

Administration of the Gregorc Style Delineator

A total of five minutes was allowed for each
participant to complete the GSD. After completing the GSD, the researcher read instructions to the participants explaining how to score the results.

The sum of this ipsative instrument must total 100 points. The researcher verified participants' scoring of the results. Any participant whose score did not total 100 points was omitted from the study. In addition, any participant who failed to complete the GSD in the allotted time frame was excluded from the study. In administering the GSD, the researcher read the instructions on how to interpret the GSD outcomes after participants had totaled their points. Of the 91 students enrolled in these classes, 50 students were selected for the voice input phase of the study. The 50 participants for the voice input phase of the study were selected based on their willingness to volunteer and on their dominant learning styles. A time when each student could work with the researcher to train on the voice input system was scheduled.

Training Participants to Use Voice Input

Each voice input phase participant was trained on the same equipment in the same office located at the Virginia Tech campus. The essentials of the equipment included: a WIN computer with a 80386 processor, 40 megabyte hard drive, 8 megabytes of RAM, soundboard, and standard microphone head set used with Dragon Dictate. The software package used for
this study was Word Perfect 5.1.

The researcher read the instructions to the participant, and the training began as shown Appendix C. The training consisted of 60 words, which included the commands necessary to operate Dragon Dictate. The default settings for Dragon consist of 200 training words. However, the researcher verified that the 60 words selected for training in this study were the sufficient for the study. In addition, each participant was instructed to pronounce each of the 60 words three times. As part of the instructions, the researcher explained how to "pause," "backup," "restart." These commands are needed if a person coughs, laughs, or mispronounces a word. The training menu is shown in Appendix D.

The training for creating a voice file lasted approximately 12 to 15 minutes for each participant. After the training, the researcher had each participant start the system with the command "Voice-Console"; "Wake Up" from the main menu as shown in Appendix E.

Next, each participant was given a list of words to practice before dictating the paragraph developed for this study to measure performance in using the voice input technology as shown in Appendix C. None of the words on the practice list was the same as a word used in the paragraph.
After completing the practice list, the participants were asked to dictate the paragraph.

The researcher then proceeded to score performance as the participant dictated. The participant was then asked to repeat the dictation. The researcher believed this would allow the participant to experience or develop an attitude toward voice input technology. While totaling the performance score, the researcher administered the Attitude Toward Voice Input Scale (ATVIS) to the participant.

Measuring Voice Input Performance

Voice input performance was measured through assessment of the participants actually dictating a paragraph using Dragon Dictate.

Paragraph Development. To develop the paragraph that was dictated by the participants the researcher used a reference that included the most commonly used words in business correspondence. The book was entitled The Word Frequency of Written Business Communications (Ober, 1981). The words selected for the paragraph were in the top 500 most frequently used. The researcher then selected 86 words and 10 punctuation marks from the top 500 and constructed a paragraph. A copy of the paragraph is shown in Appendix F.

Scoring the Paragraph. Each participant dictated the paragraph two times. However, the researcher reported the
results from the first dictation. The performance in using voice input to dictate the paragraph was determined through a point system that assigned increased points according to difficulty in achieving the voice input. In other words, the lower the individual score when dictating the voice input paragraph, the better individual performed.

Before discussing the point system that was derived for the study, a few explanations must be noted. First, Dragon Dictate uses what is called a "choice menu" with each word that is spoken. The choices can range from one to ten. This allows the user to replace a word that is misrecognized, and give the user the option to replace the misrecognized word with the correct word (e.g., choose one, choose two, choose three) as shown in Appendix G. One of the choices on this menu is the F-10 or reject choice. By choosing F-10, the user can try to pronounce the word again and keep choosing F-10 until the word is recognized by the system. If, however, the word is not recognized, the user can use the "spell-mode menu" as shown in Appendix H. This command allows the user to spell the word by using the international phonetic alphabet as shown in Appendix H.

The point system measured the individuals' performance based on the criteria listed below. A complete illustration of the scoring appears in Appendix I.

♦ 1 point was recorded for each correctly spoken word that
was recognized by Dragon Dictate on the first attempt.

♦ 2 points were recorded if the spoken word was one of the selections from the choice menu and the participant selected the correct word.

♦ 3 points were recorded if the participant had to spell the word and correctly spelled it. Option: If the participant spoke the word from the given paragraph, and the word was not shown as one of the choices to select, the participant had the option to use the spell-mode and spell the word using the international phonetic alphabet or choose to reject the misrecognized word and try again. If the participant chose to reject the word and the word was recognized this time, 3 points were recorded.

♦ 4 points were recorded if the participant spoke the word, the word was misrecognized, and the participant chose to reject the misrecognized word, and then, the participant spoke the word again and the word was once again misrecognized, but the word was one on the choice menu and the participant selected the correct choice.

♦ 5 points were recorded if the participant spoke the word and the word was misrecognized after two attempts and the word was recognized on the third attempt. Another possible way to score 5 points was if the participant spoke the word, the word was misrecognized, and the participant chose to reject the misrecognized word, and then tried to pronounce
the word again and the word was not recognized as one of the words on the choice menu, and the participant correctly spelled the word using the spell-mode menu.

♦ 6 points were recorded if the participant chose twice to reject the misrecognized word and the word did appear on the choice menu after rejecting the word twice, and the participant chose the correct word. Seven points were recorded if the participant used the option of choose to reject the misrecognized word three times and the word was recognized on the fourth attempt.

♦ 7 points were recorded if the participant used the option of choose to reject the misrecognized word three times, and decided to use spell mode and correctly spelled the word.

♦ 8 points were recorded if the participant chose to reject the misrecognized word three times and on the fourth attempt the word appeared as one of the selections on the choice menu and the participant correctly chose the word.

♦ 9 points were recorded if the word was not corrected or if any extra words were shown in the paragraph.

It is important to note that for this scoring method the lower the performance score when dictating a paragraph using voice input technology the more successful the dictation.

Results of pilot testing the Performance Scale. A total of five students who were enrolled in vocational
education at Virginia Tech in Spring 1993 semester participated in the pilot test training of the Performance Scale using Dragon Dictate. The researcher examined the dispersion among the number of points allowed for each individual and the time it took to complete the task. The researcher confirmed that there was dispersion and that the time allowed to complete the training and the performance test was approximately one hour.

Measuring Attitude Toward Voice Input

In this section, the development, pilot testing, administration, and scoring of the ATVIS are explained.

Development of the ATVIS. The ATVIS originally consisted of 30 statements, 15 positive and 15 negative. To develop the ATVIS, a focus group was used consisting of nine students enrolled in vocational education courses at Virginia Tech. The focus group was used as a source for writing the attitude statements.

To establish validity of the ATVIS, it was given to a panel of five experts who were either familiar with voice input technology or experienced in developing attitude scales. Panel members then indicated whether they agreed or disagreed that each item was valid for measuring an individual's attitude toward voice input. Items that were not clear to the panel members were either eliminated or
reconstructed. Based on the responses, the researcher determined which items could best be used in the study. The result was a 21-item instrument with a Likert-type scale. It had 11 positively worded statements and 10 negatively worded statements. The scoring of the ATVIS ranged from a possible minimum of 21 to a maximum of 84 points. The Likert-type scale had four possible categories: strongly disagree (SD); 2 = disagree (D); 3 = agree (A); 4 = strongly agree (SA). Therefore, the higher attitude score the better the attitude toward voice input technology.

**Pilot Testing the ATVIS.** The ATVIS was administered to 29 individuals enrolled in two vocational education related courses. The results were collected and analyzed to test for reliability and validity. Cronbach’s Alpha was used to determine internal-consistency reliability. The Cronbach’s Alpha for the pilot test was α = .92 indicating a moderately high reliability. Validity was established by using a statement regarding respondent’s attitudes toward technology to check for consistency of attitude toward voice input. The statement read, "Most people have had experience with using a VCR. Will you please indicate your attitude toward the VCR on the scale." The scale ranged from 1 (negative) to 7 (positive). However, the researcher found on the validity check that there was not enough dispersion in individuals attitudes toward technology. Most of the
individuals had a positive attitude toward the VCR. Therefore, the validity check on the ATVIS was not a valid measure. A correlation coefficient of $r = .15$ resulted

**Administering and Scoring the ATVIS.** After completing voice input sessions, each of the 50 participants chosen for the voice-input phase of the study was asked to complete the ATVIS. Scoring consisted of coding the positively constructed questions as strongly disagree (SD) = 1 point, disagree (D) = 2 points, agree (A) = 3 points, and strongly agree (SA) = 4 points. The negatively constructed questions were reverse coded as strongly disagree (SD) = 4 points, disagree (D) = 3 points, agree (A) = 2 points, and strongly agree = 1 point. A total, or composite score, of each individual's score was then calculated. The higher the composite score, the more positive the individual's attitude toward voice input. The participants completed the ATVIS after dictating the voice-input paragraph two times.

**Analysis of the Data**

In this section, statistical procedures used to analyze the data for each null hypothesis are explained.

**Hypothesis One.** No differences exist in the performance in dictating a paragraph using voice input for individuals with different learning styles.

Performance scores were determined by obtaining the
individuals' scores dictating the paragraph. Scores were then grouped according to dominant learning style (i.e., CS, AR, and CR). Performance score is the dependent variable. Learning style is the independent variable. The means for each learning style category regarding performance were determined and compared using an one-way analysis of variance (ANOVA).

**Hypothesis Two.** No differences exist in attitude toward voice input for individuals with different learning styles. The attitude scores were determined by obtaining each individual's score on the ATVIS. ATVIS scores were then grouped according to learning style. Attitude is the dependent variable. Learning style is the independent variable. To test this hypothesis, the means for each learning style category regarding attitude were determined and compared using an one-way analysis of variance (ANOVA).

**Hypothesis Three.** No interaction exists for the performance scores for individuals with different learning styles and different attitudes toward voice input technology.

The statistical procedure used to test this hypothesis was a two-way analysis of variance (ANOVA). The two independent variables consisted of four dominant categories of learning style and two categories of attitude, making eight cells for a two-way ANOVA. The attitude scores were
broken down into two categories at the median. The students
who scored above the median had "high" attitudes and the
students who scored below the median had "low" attitudes.
Performance score was the dependent variable.

The A Posteriori Test used for this study was the
Scheffe test. According to Nie, Hull, Jenkins,
Steinbrenner, and Bent (1975) the Scheffe "uses a single
range value for all comparisons, which is appropriate for
examining all possible linear combinations of group means
not just pairwise comparisons. Thus, it is stricter than
the other tests. Scheffe is exact, even for unequal group
sizes" (p. 428). The level of significance used in this
study was $\alpha = .05$.

Summary

In this chapter, the research design, participant
selection process, training procedures, data collection, and
data analysis were described. In addition, reliability of
the ATVIS was computed with Cronbach's alpha and was found
to be .92.

To establish validity of the ATVIS, it was given to a
panel of five experts who were either familiar with voice
input technology or experienced in developing attitude
scales. Panel members then indicated whether they agreed or
disagreed that each item was valid for measuring an
individual's attitude toward voice input. Items that were not clear to the panel members were either eliminated or reconstructed.
CHAPTER 4

FINDINGS

As noted in Chapter 1, the purpose of this study was to determine if learning styles and attitudes toward voice input technology relate to performance in using the technology. In this section, demographic data are presented including the number of study participants by gender, age, race, and learning style. Further, outcomes of the analyses of the data collected for the three null hypotheses tested for the study are presented.

Demographics

Fifty students enrolled in various teacher preparation vocational education courses at Virginia Tech participated in the voice-input phase of the this study. Of the 50 students, 30 females (60%) and 20 males (40%) participated in the study. In addition, the background of the participants was 45 white Caucasians (90%) and 5 (10%) African Americans. The average age for the participants was 24.7 years.

There were three learning styles identified for the 50 participants: concrete sequential (CS), abstract random (AR), and concrete random (CR). Due to lack of students with the abstract sequential (AS) learning style, this category was not used. There were 17 students who were
categorized as CS learners. Twelve were female students (71%) and 5 (29%) were male students. The AR group consisted of 15 students, 11 (73%) female and 4 (27%) male. The CR group consisted of 18 students, 11 female (61%) and 7 male (39%).

Analysis of Data

Three hypotheses were examined to determine if learning style and attitudes toward voice input technology relate to performance in using the technology. To analyze the data, the statistical software package Number Cruncher was used. A discussion of each hypothesis tested follows.

Hypothesis One. No differences exist in the performance in dictating a paragraph using voice input for individuals with different learning styles. This hypothesis was tested by using a one-way analysis of variance (ANOVA).

Presented in Table 1 are the performance score means and standard deviations for each individual learning style. The individuals' mean scores for the CR learning style category was 214.7. The CR learners, who performed the best, had performance scores ranging from a minimum of 171 to a maximum of 259. An one-way analysis of variance (ANOVA) was used to test whether a significant difference existed between the performance score means. Table 2 displays the source table for the one-way analysis of
Table 1

Performance Score Mean and Standard Deviation for Participants by Learning Style (N = 50)

<table>
<thead>
<tr>
<th>Learning Style</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Sequential</td>
<td>17</td>
<td>243.2</td>
<td>9.4</td>
<td>159 345</td>
</tr>
<tr>
<td>Abstract Random</td>
<td>15</td>
<td>235.9</td>
<td>10.0</td>
<td>192 283</td>
</tr>
<tr>
<td>Concrete Random</td>
<td>18</td>
<td>214.7</td>
<td>9.1</td>
<td>171 259</td>
</tr>
</tbody>
</table>

*The lower the score, the better the performance.
Table 2

*Analysis of Variance Outcomes for Performance Scores by Learning Style (N = 50)*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Value</th>
<th>P&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Style</td>
<td>2</td>
<td>7698.8</td>
<td>3849.4</td>
<td>2.6</td>
<td>.09</td>
</tr>
<tr>
<td>Error</td>
<td>47</td>
<td>70618.8</td>
<td>1502.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>78317.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
variance (ANOVA). The differences between the performance score means for the three learning styles were not significant at $\alpha = .05$ level. Therefore, Hypothesis One, no differences exist in the performance in dictating a paragraph using voice input for individuals with different learning styles was not rejected.

**Hypothesis Two.** No differences exist in attitude toward voice input for individuals with different learning styles. This hypothesis was analyzed by using an one-way analysis of variance (ANOVA).

Presented in Table 3 are the ATVIS means and standard deviations for the three learning style categories. As mentioned in Chapter 3, the ATVIS was administered after the second dictation of the voice-input paragraph. The mean for the abstract random learning style category of 65.7 was highest. The attitude scores for the AR's ranged from a minimum of 56 to a maximum of 75. An one-way analysis of variance (ANOVA) was used to test whether a significant difference existed between the attitude toward voice input means by the three learning styles. Table 4 displays the source table for the one-way analysis of variance (ANOVA). The difference between the means for attitude toward voice input by learning style were not significantly different at $\alpha = .05$ level. Therefore, Hypothesis Two, no differences exist in attitude toward voice input for individuals with
Table 3

Attitude Toward Voice Input Mean for Participants by Learning Style (N = 50)

<table>
<thead>
<tr>
<th>Learning Style</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Sequential</td>
<td>17</td>
<td>63.5</td>
<td>1.5</td>
<td>50</td>
<td>76</td>
</tr>
<tr>
<td>Abstract Random</td>
<td>15</td>
<td>65.7</td>
<td>1.6</td>
<td>56</td>
<td>75</td>
</tr>
<tr>
<td>Concrete Random</td>
<td>18</td>
<td>63.8</td>
<td>1.5</td>
<td>51</td>
<td>73</td>
</tr>
</tbody>
</table>

*The higher the score, the more positive the attitude toward voice input.*
Table 4

Analysis of Variance Outcomes for Attitude Toward Voice Input Scores by Learning Style (N = 50)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Value</th>
<th>P&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Style</td>
<td>2</td>
<td>56.2</td>
<td>28.1</td>
<td>.7</td>
<td>.50</td>
</tr>
<tr>
<td>Error</td>
<td>47</td>
<td>1860.5</td>
<td>39.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>1916.7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
different learning styles was not rejected.

**Hypothesis Three.** No interaction exists for the performance scores for individuals with different learning styles and different attitudes toward voice input technology. This hypothesis was analyzed by using a two-way analysis of variance (ANOVA).

To determine the two attitude toward voice input category scores for the participants, performance scores were totaled to obtain a mean score for each dominant category (i.e., CS, CR, and AR) grouped according to "high" or "low" attitude. The attitude scores were divided into two categories at the median. The students who scored above the median had "high" attitudes and the students who scored below the median had "low" attitudes.

Presented in Table 5 are the performance score means and standard deviations for the three individual learning style categories, for the "high" and "low" attitude toward voice input categories, and for combinations of the two categories. The mean for the concrete sequential individuals who had low attitudes toward voice input technology was the highest, 262.4. A two-way analysis of variance (ANOVA) was used to test whether a significant differences existed between performance scores for individuals by learning styles with "high" or "low" attitudes toward voice input. Table 6 displays the source
Table 5

Performance Score Mean by Learning Style and Attitude Toward Voice Input Categories (N = 50)

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning Style</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Sequential</td>
<td>17</td>
<td>235.3</td>
<td>8.8</td>
</tr>
<tr>
<td>Abstract Random</td>
<td>15</td>
<td>234.4</td>
<td>9.4</td>
</tr>
<tr>
<td>Concrete Random</td>
<td>18</td>
<td>215.3</td>
<td>8.5</td>
</tr>
<tr>
<td><strong>Attitude Toward Voice Input</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>25</td>
<td>236.7</td>
<td>7.3</td>
</tr>
<tr>
<td>High</td>
<td>25</td>
<td>219.9</td>
<td>7.3</td>
</tr>
<tr>
<td><strong>Learning Style with Attitude</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Sequential/ Low</td>
<td>11</td>
<td>262.4</td>
<td>10.9</td>
</tr>
<tr>
<td>Abstract Random/ Low</td>
<td>6</td>
<td>227.0</td>
<td>14.8</td>
</tr>
<tr>
<td>Concrete Random/ Low</td>
<td>8</td>
<td>220.8</td>
<td>12.8</td>
</tr>
<tr>
<td>Concrete Sequential/ High</td>
<td>6</td>
<td>208.2</td>
<td>14.8</td>
</tr>
<tr>
<td>Abstract Random/ High</td>
<td>9</td>
<td>241.8</td>
<td>12.1</td>
</tr>
<tr>
<td>Concrete Random/ High</td>
<td>10</td>
<td>209.8</td>
<td>11.5</td>
</tr>
</tbody>
</table>
Table 6

Analysis of Variance Outcomes for Performance Scores Based on Learning Style and Attitude Toward Voice Input (N = 50)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Value</th>
<th>P&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Style</td>
<td>2</td>
<td>4276.5</td>
<td>2183.3</td>
<td>1.6</td>
<td>.20</td>
</tr>
<tr>
<td>Attitude</td>
<td>1</td>
<td>3336.7</td>
<td>3336.7</td>
<td>2.5</td>
<td>.12</td>
</tr>
<tr>
<td>Learning Style by Attitude</td>
<td>2</td>
<td>9168.9</td>
<td>4584.5</td>
<td>3.5</td>
<td>.04*</td>
</tr>
<tr>
<td>Error</td>
<td>44</td>
<td>57896.0</td>
<td>1315.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>78317.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at α = .05 level
table for the two-way analysis of variance (ANOVA). There were no significant differences in the performance scores for learning style nor for "high" and "low" attitude toward voice input technology at the $\alpha = .05$ level. However, there was a significant interaction. For the interaction, a significant F-value of 3.48 with a probability of significance at .04 was found. Figure 1 contains the performance score means of the three learning styles by "high" and "low" attitudes.

A disordinal interaction existed. That is, the "regression lines intersect with the range of interest of the attribute." (Pedhazur & Schmelkin, 1991, p. 548) Caution must be exercised when interpreting this disordinal interaction due to the small cell sizes. The Scheffe A Posteriori Test was used test for significance at the $\alpha = .05$ level. The results of the Scheffe test showed no statistically significant differences among any of the means. Thus, Hypothesis Three was not rejected.

Summary

No significant differences were identified in testing both Hypothesis One and Hypothesis Two. For Hypothesis Three a significant interaction was found. However, A
Figure 1. Performance Score Means of the Three Learning Styles by High and Low Attitudes (Disordinal Interaction).
Scheffe A Posteriori Test used to test for significant differences revealed that no significant differences existed. Therefore, Hypothesis Three was rejected.
CHAPTER 5

SUMMARY, CONCLUSIONS, DISCUSSION, AND IMPLICATIONS

This study was conducted to explore whether learning style and attitudes toward voice input technology relate to performance in using the technology. In this section, a summary, conclusions, and implications are presented based on the data gathered during the study.

Summary

In this section, the background, methodology, and findings of the study are summarized.

Background

Voice input technology as applied to commercial and educational use today is in its infancy. For years, researchers have been interested in the idea of using speech to communicate with machines. In the 1950s, companies such as IBM and AT&T spent millions of dollars trying to create a computer such as "HAL," the intelligent computer in the movie "2001," that could communicate with spoken language. However, these attempts fell short of producing easy to use, inexpensive technology mainly because of limited funding, lack of resources available for voice input research, and limitations of available equipment.

Voice input has become a reality and is being used commercially in a variety of settings including aviation,
health care, telephone, and banking industries, as well as the United States Postal Service (Cordy, 1990; Coursey, 1990). Moreover, voice input is becoming a more acceptable concept to the general public with the increased use of new technology.

With the recent passage of the Americans with Disabilities Act and with people sustaining repetitive strain injuries such as carpal tunnel syndrome from keyboard input, voice input technology is becoming more broadly accepted. A need to train people who have various disabilities to use voice input technology exists. Thus, educational institutions must take advantage of the technology and provide proper training for its use. (McGilchrist, 1990; Reddy, 1979).

To date, it is not clear whether voice input will emerge as the primary means of data input in the future. Most of this uncertainty relates to years of research aimed at discovering new alternatives to the keyboard. Various attempts to replace the keyboard and redesign it have not, however, overcome the dominant presence of the standard keyboard. As voice input continues to grow and new uses for it evolve, this technology may replace many keyboards as well as supplement most others.

Regardless of whether or not voice input technology replaces the keyboard as a means of data input, it is
important for educators to research its use as they would any new information processing technology. Further, teachers should become aware of how learning styles and attitudes toward voice input technology affect students' acceptance of it.

Methodology

For this study, the researcher examined the use of voice input technology with 50 college students enrolled in vocational teacher education preparation courses at Virginia Tech. Each student completed a learning style instrument, the Gregorc Style Delineator (GSD). The GSD encompasses four learning style groups: concrete sequential (CS), abstract sequential (AS), abstract random (AR), and concrete random (CR) (Gregorc, 1984). For this study, only the CS, AR, and CR categories were used. There were not enough participants who had the abstract sequential learning style.

After the students completed the learning style instrument, they were asked to complete a data sheet to provide background information about themselves. Participants recorded their age, gender, and whether they were willing to participate in the voice-input training phase of the study on a volunteer basis. Each of the 50 voice-input phase participants was trained on the same
equipment in the same office located on the Virginia Tech campus.

The voice input training lasted approximately 12 to 15 minutes for each participant. After completing the training phase, the researcher had each participant start the voice input system. Next, each participant was given a list of words to practice before dictating the paragraph developed to measure performance in using the voice input technology. None of the words on the practice list were the same as the words used in the paragraph. After completing the practice list, each participant was asked to dictate the paragraph once for scoring. Each participant then dictated the paragraph a second time to allow for experiences with the technology and to develop an attitude toward it. The researcher proceeded to total the performance score. While totaling the performance score, the researcher administered the Attitude Toward Voice Input Scale (ATVIS) to the participant. The ATVIS consisted of 21 items, 11 positive and 10 negative. It uses a Likert-type scale with four possible categories: strongly disagree (SD); disagree (D); agree (A); strongly agree (SA).

The performance score data were analyzed through analyses of variance to test for significant differences at a priori a level of .05. If significant differences were identified, the Scheffe A Posteriori test was used to
determine the source of the differences.

Findings

Fifty students enrolled in various vocational teacher education preparation courses at Virginia Tech participated in this study. The 50 students included 30 females (60%) and 20 males (40%). In addition, the background of the participants was 45 white Caucasians (90%) and 5 (10%) African Americans. The average age of the participants was 24.7 years.

Hypothesis One. No differences exist in the performance in dictating a paragraph using voice input for individuals with different learning styles. This hypothesis was tested by using an one-way analysis of variance (ANOVA). The difference between performance scores for individuals of different learning styles was not significant at $\alpha = .05$ level. Therefore, Hypothesis One was not rejected. Students' learning styles, concrete sequential, abstract random, or concrete random, do not relate to their performance when dictating a paragraph using voice input technology.

Hypothesis Two. No differences exist in attitude toward voice input for individuals with different learning styles. This hypothesis was tested by using an one-way analysis of variance (ANOVA). The difference between attitude scores for individuals of different learning styles
was not significant at $\alpha = .05$ level. Therefore, Hypothesis Two was not rejected. Students' attitudes toward voice input technology was not related to learning style--concrete sequential, abstract random, or concrete random.

_Hypothesis Three._ No interaction exists for the performance scores for individuals with different learning styles and different attitudes toward voice input technology. This hypothesis was tested by using a two-way analysis of variance (ANOVA). The two independent variables consisted of three categories of learning style and two categories of attitude, making eight cells for the two-way ANOVA. The attitude scores were divided into "high" and "low" categories at the median. Performance score was the dependent variable.

No significant differences for learning style and "high" and "low" attitude toward voice input technology for the performance scores were found. However, there was a significant interaction, with an F-value of 3.48, significant at $\alpha = .05$ level. A disordinal interaction existed as shown in Figure 5 in Chapter 4. The Scheffe A Posteriori Test was used to test for significance at the $\alpha = .05$ level. The results of the Scheffe test indicated no significant differences between any of the means. Students' learning style concrete sequential, abstract random, or concrete random regardless of their attitudes toward voice
input (high or low) were not related to their performance scores.

Thus, no significant differences were identified in testing Hypothesis One and Hypothesis Two. For Hypothesis Three, a significant interaction was found. However, A Scheffe A Posteriori Test used to test for significant differences, did not identify the source of the differences. Therefore, Hypothesis Three was not rejected. However, small cell sizes in the analysis limit the usefulness of this part of the study.

Conclusions

The purpose of this study was to determine if learning style and attitudes toward voice input technology relate to performance in using the technology for vocational teacher preparation students. One main conclusion was drawn from the findings: knowing students' learning styles and attitudes would not generally be of use to vocational educators as an indicator of students' performance using voice input technology.

For Hypothesis One, the researcher found no significant differences in performance scores with students' having different learning styles. Therefore, a student's learning style did not play a significant role in determining a student's performance when dictating a paragraph using voice
input. The results of Hypothesis One are in agreement with Lundstrom (1986), who found no significant interaction between method of instruction and students' dominant learning styles. Similar to Lundstrom's (1986) results, outcomes from testing Hypothesis One lead to the conclusion that learning styles do not appear to be contributing factors for instructional purposes in this situation. Based on the findings of Hypothesis One, instructors will not need to adapt teaching strategies for students with different learning styles when use of voice input technology is implemented into the curriculum for vocational teacher education students.

In Hypothesis Two, the researcher found no significant differences in attitude scores for students' having different learning styles. Therefore, a student's learning style does not relate to a student's attitude. While not statistically significant, Concrete Sequential individuals had the lowest attitude scores among the three learning style groups. No prior research has examined attitudes toward voice input technology and learning styles. Based on Hypothesis Two findings, knowing a student's learning style will not help an instructor to understand a student's attitude toward voice input technology.

However, when results are considered from Hypothesis Three regarding attitude, learning styles may be a factor to
consider in providing voice input instruction. For Hypothesis Three, attitude was categorized as "high" or "low." For it, no statistically significant interaction existed in the performance scores for individuals with different learning styles and different attitudes toward voice input technology. In other words, the following six means were not significantly different when tested statistically: concrete sequential-high attitude; concrete sequential-low attitude; abstract random-high attitude; abstract random-low attitude; concrete random-high attitude; and concrete random-low attitude.

To review, no statistically significant differences were found for Hypothesis Three. For the overall conclusion, the researcher stated that knowing students' learning styles and attitudes would not generally be of use for vocational educators as an indicator of students' performance using voice input technology. If the outcomes for the statistical analyses are narrowly interpreted, the conclusion that knowing a students' learning style and/or attitude would not be of use could be drawn.

However, individuals with concrete sequential learning styles who had "high" attitudes toward voice input had better performance scores than those with "low" attitudes toward the technology. Caution must be exercised, however,
when interpreting this disordinal interaction because of the small cell sizes.

Concrete individuals tend to be very orderly and look for cause and effect relationships. Concrete sequential individuals like efficiency and getting incentives for hard work. The relationship between work and incentive becomes a driving force in their lives (Gregorc, 1982a). Concrete sequential individuals that were categorized as having a "low" attitude also had the poorest performance scores. From this, it appears that concrete sequential individuals with low attitudes are not likely to try as hard as they might without an incentive for their efforts.

In regard to abstract random and concrete random participants, these individuals' attitudes, as measured in this study, did not significantly relate to their performance scores. This may have been precipitated by the randomness element of the learning styles. Randomness is characterized by Gregorc (1982a) as individuals who like variety, creativity, spontaneity, and enjoyment of new experiences. People with randomness characteristics tend not to be organized, prioritized, or focused on time; whereas individuals with the sequential element of the learning style characterize themselves as having these characteristics. For this study, the attitudes for concrete random and abstract random individuals were more positive
toward voice input technology than individuals with concrete sequential learning styles. Concrete random and abstract random individuals may have seen voice input as a new and curious experience, whereas the concrete sequential individuals may have seen this experience as a waste of their time.

Interpreting the results from the three hypotheses of this study in a narrow fashion, could lead one to conclude that they are not harmonious to Helgesen's (1986) findings. Helgesen found that students who evaluated their teachers as "high" had similar learning styles to their teachers. This implies that knowing a student's learning style is important to good instruction and may increase motivation for students to perform better than students whose learning styles do not match their teachers' learning styles.

Narrowly interpreting the findings for the three hypotheses would not suggest that learning styles are related to instruction. However, taking into account the differences in performance scores for concrete sequential learning-style individuals with "high" and "low" attitudes toward voice input technology, learning styles could indeed be an important factor in the use of the technology.

Outcomes for the three hypotheses tested indicate that knowledge of students' attitudes and learning styles are not of value to vocational educators in providing instruction.
for voice input technology. However, individuals with concrete sequential learning styles, with different attitudes, appear to perform differently when using voice input. Therefore, rather than concluding that learning style is not important to vocational educators as an indicator of students' performance when using voice input, a more realistic conclusion can be stated. It is that knowing students' learning styles and/or attitudes would not generally be of use to vocational educators as an indicator of students' performance using voice input technology.

Discussion

Although there were no statistically significant results in this study, it is fair to discuss some limitations that may have influenced this lack of significant findings. Fifty students preparing to become vocational teachers who were enrolled in vocational education methodology, curriculum development, and related courses at Virginia Tech participated in the study. Of the 50 students who participated 17 had concrete sequential learning styles, 15 had abstract random learning styles, and 18 had concrete random learning styles. Because of the limited number of individuals who participated in the study, the two way analysis of variance for Hypothesis Three had small cell sizes ranging from 6 to 11 per cell. Hypothesis
Three read "no interaction exists for the performance scores for individuals with different learning styles and different attitudes toward voice input technology." The two independent variables consisted of three categories of learning style and two categories of attitude, making eight cells. With larger cell sizes finding a statistically significant difference would have been more likely to occur. For the analyses, the attitude scores were divided into "high" and "low" categories at the median. The participants in the study scored between 50 and 76 on the attitude scale out of a possible range of 21 to 84. Therefore, all the participants had what might be characterized as a moderate to a high positive attitude toward voice input technology.

In addition, the individuals with concrete random learning styles performed the best on using voice input with a mean of 214.7 as compared to the abstract random and the concrete random individuals who scored 235.6 and 243.2, respectively. Thus, the concrete random individuals had noticeably better performance scores than the abstract random and concrete sequential learning style groups. This might suggest that there was practically important difference with the concrete random individuals. For, instructional purposes, individuals with concrete sequential learning styles and individuals with abstract random learning styles might experience more difficulty when using
voice input equipment than those with concrete random
learning styles.

Implications

Based upon the findings and conclusions of this study, the
following implications for instruction and additional
research are provided.

Implications for Instruction

1. Finding no significant differences in students' learning
styles and attitudes toward voice input indicates that
learning style may play no part in students' acceptance of
the technology. Using learning style instruments other than
the Gregorc Style Delineator may detect learning styles that
do relate to voice input technology.

2. Given that attitude and incentives may be important for
congeate sequential individuals and that the performance of
those with "high" and "low" attitudes toward voice input
technology appeared to differ in this study, teachers should
consider giving assignments in a manner to show relevance of
future applications of voice input for individuals with
congeate sequential learning styles. Also, incentives
should be given for voice input assignments that are well
done.
Implications for Additional Research

1) Further research should be done with a larger group of students and different types of students relating the four learning style categories of the Gregorc Style Delineator to voice input technology. In this study, 50 individuals participated in the voice-input phase and only three learning style categories were used due to lack of participants with abstract sequential learning style.

2) This research should be replicated using different types of voice input technology and, as it is developed, voice input technology with more advanced capabilities. In this study, financial constraints allowed for use of only one voice input system that was available to the researcher. This system was Dragon Dictate from Dragon Systems Incorporated.

3) This study should be replicated using different types of voice input data, including graphics, spreadsheet, and database. In this study, the researcher used the word processing application software WordPerfect, version 5.1. Therefore, using Dragon Dictate with other software applications may yield different results.

4) This study should be completed using free dictation to measure performance instead of dictation from given text. The individuals who participated in this study, did not use free dictation.
5) A qualitative research study should be completed to examine in depth participants' reactions to the use of voice input technology. Due to the lack of a random sample, the generalizability of this study was limited to the 50 individuals who participated.
REFERENCES


APPENDIX A:

The Attitude Toward Voice Input Scale (ATVIS)
The Attitude Toward
Voice Input Scale (ATVIS)

Directions for the Attitude Toward Voice Input Scale:
Each of the statements listed below expresses a feeling that a person has toward voice input. Based on your experience with voice input technology, indicate, on a four-point scale, the response that best expresses the way you feel (your own personal feeling) toward voice input. Please circle the response that best indicates how closely you agree or disagree with the feeling expressed in each statement.

The responses are as follow:  
SD = Strongly Disagree
D = Disagree
A = Agree
SA = Strongly Agree

1. Voice input is easy to learn.  
   SD D A SA

2. It really makes me nervous to even think about using voice input.  
   SD D A SA

3. Voice input is fun to use.  
   SD D A SA

4. Talking to a monitor when using voice input is uncomfortable.  
   SD D A SA

5. Voice input is user friendly.  
   SD D A SA

6. Voice input is frustrating to use.  
   SD D A SA

7. Voice input is more efficient to use than the keyboard.  
   SD D A SA

8. Voice input is difficult to learn.  
   SD D A SA

9. Voice input is state-of-the-art technology.  
   SD D A SA

10. Voice input increases productivity.  
    SD D A SA
11. Voice input creates jobs.

12. Voice input is threatening to use.

13. Voice input is useful for the physically disabled.


15. I react positively to voice input.

16. When using voice input I get impatient.

17. Mistakes occur frequently when using voice input.

18. Voice input technology is the wave of the future.

19. Voice input is more tedious to use than the keyboard.

20. Voice input creates unemployment.

21. I really like voice input.
APPENDIX B:

Background Information - Part 1 and Part 2

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Background Information - Part 1

Please complete the following information.

Male ____ Female____
  (please check one)
Age ____

Ethnic Background

Caucasian ____

African American ____

Hispanic ____
(please check one)

Other (please identify) __________________________
Part 2

Background Information

Dear student:

I am undertaking a research project that involves training on a computer system called Dragon Dictate. Dragon is a high-tech computerized voice-activated system and is capable of recognizing your speech. That's right. As you speak into the computer, the computer learns your speech patterns and pronunciations of words and stores these words in a file or what is commonly "coined" a voice file.

Dragon is considered by many as an alternative to the keyboard as a means of data input. However, to get an accurate notion of how this technology will perform in everyday life, I will need approximately 50 students to participate in the project. If selected, you will be trained on how to dictate to this computer. Arrangements will be scheduled at your convenience. The duration of the training will be approximately 60 minutes.

Please check one:

___ If selected, I am interested in participating in the use of Dragon Dictate.

___ I am unable to participate in the use of Dragon Dictate.
APPENDIX C:

Training Instructions - Part 1 and 2
Training Instructions - Part 1

Instructions for each participant are as follow:
For proper training on Dragon Dictate it is necessary to train the system to recognize your voice. Each time you see PLEASE SAY repeat the word shown three times. After you say the word three times the next word will follow. Repeat this process until you have completed the 60 words selected for your training by the researcher. To pause to clear your throat or drink some water you may use one of the following commands. If you decide to pause use the Pause (P) key located on the keyboard. To continue press any key. If you cough, laugh, or mispronounce a word, use the Restart (R) key located on the keyboard. If you want to repeat a word after you say the word three times and Dragon prompts the next word, use the Backup (B) key located on the keyboard. For your convenience, Dragon has supplied a complete list of these words and are shown while you are training. Relax and pause one fourth (1/4) of a second after pronouncing each word as you speak. Please begin.
Training Instructions Part 2

Now that you have completed your training, the next step is to practice speaking 14 words. They are as follow:

(1) expense          (8) safety
(2) below            (9) study
(3) loan             (10) water
(4) college          (11) material
(5) costs            (12) good
(6) division         (13) president
(7) cost             (14) data

There are three commands you must be able to use for this study. **First**, the Choose Command. If you speak the word "expense" and Dragon recognizes the word as "hence," you can look on the choose list and should "expense" be one of the choices located beside F-3, for example say Choose 3.

**Second**, if you speak the word "good" and Dragon recognizes the word as "hood" and the word "good" is not on the choose list, you can either say Choose 10 to reject the word or you can say Spell Mode. If you choose to say Spell Mode you must use the international letter code to spell the word until it becomes one of the choices on the Choose List. For example, to spell "good" you would say Golf... Oscar... Oscar... Delta. If you choose F-10 Reject you can try saying "good" again and again until the word "good" is recognized by Dragon.
APPENDIX D:

The Training Menu

### The Training Menu

<table>
<thead>
<tr>
<th>Train</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>G Train GROUP of words</td>
<td>Instances: 3</td>
</tr>
<tr>
<td>W Train specific WORD</td>
<td>Untrained only: YES</td>
</tr>
<tr>
<td>A Train ALL</td>
<td>Pause between: NO</td>
</tr>
<tr>
<td>O OPTIONS</td>
<td></td>
</tr>
<tr>
<td>Q Quit</td>
<td></td>
</tr>
</tbody>
</table>

**Please say the phrase:** voice-console

**Word 1 of 60** Instances 1 of 3

**Press P,R,S, or Q to:** Pause, Restart, Ship, Quit
APPENDIX E:

Voice Console Main Menu

Voice Console Main Menu

- WAKE UP
- CONFIGURATION
- EDIT
- SAVE
- NEW USER
- REVERT TO SAVED
- TRAIN
- OPTIONS
- PARAMETERS
- STATISTICS
- RESET STATISTICS
- QUIT
APPENDIX F:

Voice-Input Paragraph
The committee members have reviewed all related details of your report for developing a new computer system. In fact, many members indicated that they are interested in signing an agreement that would make this product available at market price. Further, we believe that people who purchase this equipment will be very satisfied with the results. Scheduling training is available upon request. If questions occur regarding our contract, please feel free to call or write. I can be contacted at my company. Thank you for your business.
APPENDIX G:

The Choice Menu


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The Choice Menu

expense

f1 expense
f2 hence
f3 hockey
f4 man
f5 rinse
f6 exact
f7 examine
f8 clean
f9 exclude
f10 [reject]
APPENDIX H:

Spell-Mode Menu

Spell-Mode Menu

Many figures

<table>
<thead>
<tr>
<th>many figures [spell mode]</th>
</tr>
</thead>
<tbody>
<tr>
<td>f1 features</td>
</tr>
<tr>
<td>f2 feature</td>
</tr>
<tr>
<td>f3 featuring</td>
</tr>
<tr>
<td>f10 [reject]</td>
</tr>
</tbody>
</table>

The word is features.

"As the word is spelled, "features" replaces "figures."

International Communications Alphabet:

A = [alpha]  N = [november]
B = [bravo]   O = [oscar]
C = [charlie] P = [papa]
D = [delta]  Q = [quebec]
E = [echo]   R = [romeo]
F = [foxtrot] S = [sierra]
G = [golf]   T = [tango]
H = [hotel]  U = [uniform]
I = [india]  V = [victor]
J = [juliett] W = [whiskey]
K = [kilo]   X = [xray]
L = [lima]   Y = [yankee]
M = [mike]   Z = [zulu]

F [foxtrot], E [echo], A [alpha], T [tango], U [uniform],
R [romeo], E [echo], S [sierra]
APPENDIX I:
Voice Input Point System


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"One Point"

business

f1 business
f2 bus
f3 busy
f10 [reject]

The word is "business."

User says: business
Recognized as: business
Continue to next word
"Two Points"

company

f1 company
f2 business
f3 busy
f10 [reject]

The word is "business."

User says: business
Recognized as: company
User says: choose two (f2)
Recognized as: business
Continue to next word
"Three Points"

company

f1 company
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: company
User says: choose ten (f10)

business

f1 business
f2 money
f3 busy
f10 [reject]

The word is "business."

User says: business
Recognized as: business
Continue to next word
"Three Points"

company

f1 company
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: company
User says: spell mode

company

business [spell-mode]

f1 business
f2 house
f3 bus
f10 [reject]

The word is "business."

"As the word is spelled, "business" replaces "company."

User says: spells out the word business
User says: choose one (f1)
Continue to next word
"Four Points"

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)

The word is "business."

User says: business
Recognized as: busy
User says: choose three (f3)
Continue to next word
"Five points"

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)
"Five Points" (Continued)

business

- f1 business
- f2 money
- f3 honey
- f10 [reject]

The word is "business."

User says: business
Recognized as: business
Continue to next word
"Five Points"

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: spell mode
"Five Points" (Continued)

busy

<table>
<thead>
<tr>
<th>business [spell-mode]</th>
</tr>
</thead>
<tbody>
<tr>
<td>f1 business*</td>
</tr>
<tr>
<td>f2 house</td>
</tr>
<tr>
<td>f3 bus</td>
</tr>
<tr>
<td>f10 [reject]</td>
</tr>
</tbody>
</table>

The word is "business."

"As the word is spelled, "business" replaces "busy."

User says: spells out the word business
User says: choose one (f1)
Continue to next word
"Six Points"

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)

busy

f1 busy
f2 money
f3 bravo
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)
"Six Points" (Continued)

busy

f1 busy
f2 money
f3 business
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose three (f3)
Recognized as: business
Continue to next word
"Seven Points"

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)

busy

f1 busy
f2 money
f3 bravo
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)
"Seven Points" (Continued)

**busy**

- f1 busy
- f2 money
- f3 bravo
- f10 [reject]

The word is "business."

User says:  business  
Recognized as: busy
User says:  choose ten (f10)

**business**

- f1 business
- f2 money
- f3 honey
- f10 [reject]

The word is "business."

User says:  business  
Recognized as: business
Continue to next word
"Seven Points"

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)
"Seven Points" (Continued)

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: spell mode

busy

business [spell-mode]

f1 business
f2 house
f3 bus
f10 [reject]

The word is "business."

"As the word is spelled, "business" replaces "busy."

User says: spells out the word
business
User says: choose one (f1)
Continue to next word

129
"Eight Points"

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)
"Eight Points" (Continued)

busy

f1 busy
f2 money
f3 honey
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose ten (f10)

busy

f1 busy
f2 money
f3 business
f10 [reject]

The word is "business."

User says: business
Recognized as: busy
User says: choose three (f3)
Continue to next word
"Nine Points"

Nine points were recorded for any extra words that were not shown in the paragraph or any words attempted more than eight times.
VITA

Randolph (Randy) Scott Fournier was born in Amsterdam, New York on August 4, 1963. Randy grew up in Westbrook, Maine where he attended the Westbrook public schools. He received a B.S. degree in business administration in 1986 at the University of Southern Maine.

Randy continued his education by attending James Madison University (JMU) in Harrisonburg, Virginia in 1987. He graduated from JMU in 1989, completing a M.S. degree in Education.


Randy's work experience is diversified. He was employed as an accountant with Portland Glass in Portland Maine for over three years. He has also taught at the secondary level in business education and in alternative education. Other work experience includes: accounting
software consultant, customer relations assistant, and most recently a graduate teaching assistant (GTA). During his two years as a GTA at Virginia Tech, Randy taught four classes in business education, supervised student teachers, served as recording secretary for Delta Pi Epsilon, and provided presentations on voice input, the educational system in Finland, and the development of supplementary software manuals. In addition, he is a member of the National Business Education Association, American Vocational Association, International Society for Business Education, Southern Business Education Association, and Phi Delta Kappa.

Randolph Scott Fournier