A COMPARATIVE ANALYSIS OF STYLE OF USER INTERFACE LOOK AND FEEL IN A SYNCHRONOUS COMPUTER SUPPORTED COOPERATIVE WORK ENVIRONMENT.

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The purpose of this study is to determine whether the style of a user interface (i.e. its *look and feel*) has an effect on the usability of a synchronous computer supported cooperative work (CSCW) environment for delivering Internet-based collaborative content. The problem motivating this study is that people who are located in different places need to be able to communicate with one another. One way to do this is by using complex computer tools that allow users to share information, document, programs, etc. As an increasing number of business organizations require workers to use these types of complex communication tools, it is important to determine how users regard these types of tools and whether they are perceived to be *useful*. If a tool, or interface, is not perceived to be useful then it is often not used, or used ineffectively. As organizations strive to improve communication with and among users by providing more Internet-based collaborative environments, the users' experience in this form of delivery may be tied to a style of user interface look and feel that could negatively affect their overall acceptance of the collaborative environment. The significance of this study is that it applies the technology acceptance model (TAM) as a tool for evaluating style of user interface look and feel in a collaborative environment, and attempts to predict which factors of that model, perceived ease of use and/or perceived usefulness, could lead to better acceptance of collaborative tools within an organization.

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CHAPTER 1

INTRODUCTION

With the widespread usage of electronic communication facilities such as facsimile, email, teleconferencing, and video-conferencing, physical meeting places have become less of a necessity (Prabhakar, 1999). Additionally, telecommuting, or working from home, which allows users to communicate with their primary office location via computer which began in the 1980s (Venkatesh and Vitalari, 1992) has gained momentum with improved support in recent years, and this has limited the need for physical meeting places. As a result, many forms of computer supported cooperative work (CSCW) environments, such as email, have become an almost ubiquitous part of many organizations, but other forms of CSCW systems have not been as universally accepted (Orlikowski, 1993). Research aimed at increasing our understanding of user acceptance of various CSCW environments represents an important direction for CSCW research (Nunamaker, 1997).

Purpose of this Study

Technologies that may support the collaborative work of distributed teams include Internet based software such as: meeting software, audio and video conferencing software, Internet enabled groupware, messaging, application sharing software and remote access software. In addition, a host of supporting technologies such as satellite communications, high bandwidth communications media, Internet access technologies, telecommunications devices etc., may be used to provide telecommunications infrastructure. The purpose of this study is to determine whether the style of a user interface (i.e., its *look and feel*) has an effect on the usability of a synchronous computer supported cooperative work environment for delivering Internet-based collaborative content.

Problem Statement

The problem motivating this study is that people who are located in different places need to be able to communicate with one another. One way to do this is by using complex computer tools that allow users to share information, documents, programs, etc. As an increasing number of business organizations require workers to use these types of complex communication tools, it is important to determine how users regard these types of tools and whether they are perceived to be *useful*. If a tool, or interface, is not perceived to be useful then it is often not used, or used ineffectively. As organizations strive to improve communication with and among users by providing more Internet-based collaborative environments, the users' experience in this form of delivery may be tied to a style of user interface look and feel that could negatively affect their overall acceptance and satisfaction of the collaborative environment.

Significance of this Study

The significance of this study is that it applies the technology acceptance model (TAM) as a tool for evaluating style of user interface look and feel in a collaborative environment, and attempts to predict which factors of that model, perceived ease of use and/or perceived usefulness, could lead to better acceptance of collaborative tools within an organization.

Framework

The theoretical framework for this study integrates several different knowledge areas of computing. The first area includes human computer interaction (HCI) that looks at the broad area of human-computer interaction and how different factors affect users' performance (Davis et al., 1992; Draper, 1996; Preece et al., 1994). A subset of HCI is the area of usability that focuses on how different characteristics of a computer interface affect whether a user likes, or dislikes, a particular interface (Davis, 1989; Gefen & Straub, 2000; Gray & Draper, 1997; Morris & Dillon, 1997; Nielsen & Phillips, 1993; Shaw, 2002). The third area includes computer supported cooperative work environments as the delivery mechanism for information that must be shared among users who are not located in the same room (Greenberg, 1999; Grudin, 1991, 1994; Swigger, 1996; Swigger et al., 1997; Swigger et al., 1999). By combining these three knowledge areas into an integrated research framework, we can discover which factors might lead to a greater acceptance rate of a CSCW interface.

Background

The term *interaction style* has several different meanings. Depending on the computing system, it may refer to a command language, function keys, direct manipulation device, form fill-in technique, or a menuing system. In general, it refers to the method by which the user communicates with the computer system and receives output (Draper, 1996). This standard input and output process constitutes the user interface and conveys a particular look and feel of the system. The style or look and feel of the interface can have several different effects on users.

The different effects on the user can directly impact the user's perception of the computer system's usability. In general, HCI researchers (Card et al., 1983; John M. Carroll & Thomas, 1982; Norman, 1990) measure ease of use in terms of task timings and error rates. However, objective measures may, or may not, indicate whether the end user actually believes that the computer system is easy to use (John M. Carroll et al., 1988). Since studies indicate that if users think positively about a system they will use it more frequently, it is important to discover how users perceive different interfaces. In order to answer this particular question, a more subjective form of evaluation is needed to determine the overall acceptance rate of a computer interface.

The technology acceptance model (TAM) has been used frequently to obtain a more subjective measure of a computer system's acceptance by end users. TAM, as defined by Davis (1989), utilizes the user's perceptions of a system's usefulness and ease of use to determine if users will accept, or reject, an information technology system. Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). Perceived ease of use refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989).

Using TAM's definition of usefulness and ease of use, the following research hypotheses will be evaluated:

H1: Interface style has an effect on a user's perceived ease of use of a collaborative technology.

H2: Level of experience using different software applications has an effect on a user's perceived ease of use of a collaborative technology.

H3: Interface style has an effect on a user's perceived usefulness of a collaborative technology.

H4: Level of experience using different software applications has an effect on a user's perceived usefulness of a collaborative technology.

Overview of Methodology

The methodology used in this study was quasi-experimental. It simulated the use of an Internet based collaborative environment by distributed groups. In order to determine whether one particular CSCW style (i.e., interface) is more acceptable than another, two different interfaces were created. Both interfaces allowed users to work synchronously to solve group problems assigned as part of their regular course work. Both interfaces that were developed contained an electronic whiteboard, group chat, individual chat, file sharing, application sharing, and Web browsing tools. However the way that the user interacts with the two different systems (i.e., the interface style) was different.

Limitations

This study was undertaken with the following limitations:

1. The method for population sampling was one of convenience rather than random.
2. The study was limited in that only student subjects at the University of North Texas participated in the study.
3. The study was limited in that only two possible CSCW interfaces were reviewed.
4. The study relied upon self-reported usage. Previous research (Szajna, 1994; Taylor & Todd, 1995) with TAM has raised questions regarding the fidelity of self-reported usage data and its relationship to the TAM constructs.

Organization of the Dissertation

This chapter introduced the need to study interface style of an Internet based collaborative environment and presented the hypotheses that are addressed in this study. In Chapter 2, the relevant literature is reviewed that leads to the development of the research hypotheses in question. Chapter 3 outlines the methodology used in the study. Chapter 4 presents the results of the statistical tests used to test the hypotheses presented in Chapter 2. Implications of this study and suggestions for future research are discussed in Chapter 5.

CHAPTER 2

LITERATURE REVIEW

The aim of this chapter is to bring together the research areas that are of importance to this study. The areas in questions are human computer interaction (HCI), computer supported cooperative work (CSCW) environments, usability and the technology acceptance model (TAM).

Human Computer Interaction

Vannevar Bush (1945) asked that we "consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and to coin one at random, 'memex' will do…It is an enlarged intimate supplement to his memory" (p. 11). A very simple statement, but the idea of a computer and human being closely linked together has gone through many different interpretations over the years. In 1960, J. R. C. Licklider (1960) discussed the idea of man-computer symbiosis, and suggested that the human brain and computer would be linked together tightly. In addition to describing how the brain and computer would be linked, he outlined a series of prerequisites that assisted with the association, which included: computer time-sharing, memory components, programming languages, and input and output equipment. Following this, Ivan Sutherland's Sketchpad (1963) created one of the first graphical user interfaces and the term *icon* was coined as a description of the idea that graphical images could represent abstract entities. This landmark work on graphical user interfaces, icons, and direct manipulation influenced the team at Xerox PARC that was working on the Xerox Star workstation (Johnson et al., 1989), often considered the forerunner to the Apple Macintosh® (Apple Computer, Inc., http://www.apple.com) and

Microsoft Windows® (Microsoft Corporation, http://www.microsoft.com) interfaces we have today.

Although there appear to be many definitions of human-computer interaction (HCI) (Card et al., 1983; Dix et al., 1998; Helander et al., 1997; Preece et al., 1994), the following served as the basis for this dissertation: "human-computer interaction is a discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use, and with the study of major phenomena surrounding them" (ACM-SIGCHI, 1992, p. 5). The following diagram (see Table 1, Preece et al., 1994) lists the major research areas of the HCI discipline. In this study, the *user* and *user interface* areas were of particular importance. The user is important because they will be evaluating the interface style. And the user interface was important because it is the object that the user perceives.

Table 1

Factors in HCI

<table>
<tr><td colspan="2">Organizational Factors
training, job design, politics, roles, work organization</td><td colspan="2">Environmental Factor
noise, heating, lighting, ventilation</td></tr>
<tr><td>Health and Safety Factors
stress, headaches, musculo-skeletal disorders</td><td colspan="2">Cognitive processes and capabilities
The User
motivation, enjoyment, satisfaction, personality, experience level</td><td>Comfort Factors
Seating, equipment layout</td></tr>
<tr><td colspan="4">User Interface
input devices, output displays, dialogue structures, use of color, icons, commands, graphics, natural language, 3-D, user support materials, multi-media</td></tr>
<tr><td colspan="4">Task Factors
easy, complex, novel, task allocation, repetitive, monitoring, skills, components</td></tr>
<tr><td colspan="4">Constraints
costs, timescales, budgets, staff, equipment, building structure</td></tr>
<tr><td colspan="4">System Functionality
hardware, software, applications</td></tr>
<tr><td colspan="4">Productivity Factors
increase output, increase quality, decrease costs, decrease errors, decrease labor requirements, decrease production time, increase creative and innovative ideas leading to new products</td></tr>
</table>

According to Preece et al. (1994), it is the system's image that combines the interface that a user will see and the documentation of the interface. This is significant because the user's perception of the system image is how they will judge the system as a whole. This requires the designer of the system to convey as much information as possible through the interface style, see Figure 1 (Norman & Draper, 1986).

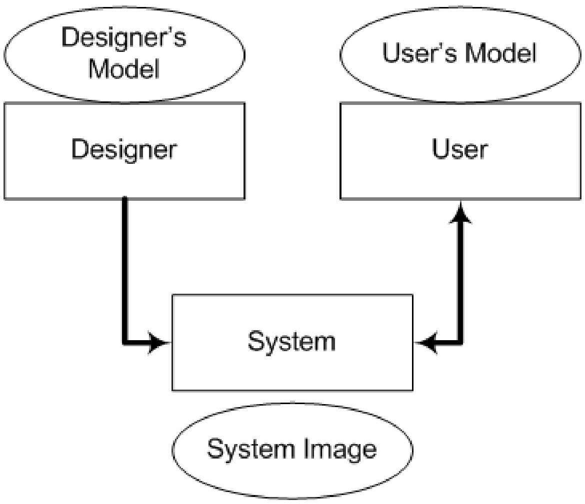


Figure 1. System image.

In this study, the user interface style under consideration is commonly referred to as a graphical user interface (GUI). Modern GUIs were first introduced as an artifact of the Xerox Star project (D. C. Smith et al., 1982). The Xerox Star brought about a change in the way users typically interacted with a computer (Miller & Johnson, 1996). Prior to the Xerox Star project, most users interacted with a computer using such things as command lines, punch cards, tape, and other primitive forms. When the Xerox Star was introduced, it allowed users to interact with items much like they would on their desk, thus the name virtual desktop. The user would then manipulate the items on the desktop by using a mouse.

As the field of user interfaces matured, other terms became synonymous with the term GUIs, most notably the word WIMP (i.e., windows, icons, mice, and pull-down menus) (Raymond, 1996). The term WIMP refers to the parts of the GUI the user would use to navigate through the interface. For example, the main interface feature for this type of GUI is a window. The window may contain icons that represent items the user can manipulate. The window can also have pull-down menus that allow the user to make selections. The user often uses a pointing device such as a mouse to select different items from a menu.

Another term used to describe a GUI is a direct manipulation interface, or DMI. (Shneiderman, 1983) A DMI describes how the interface and the user work together. For example, if the user wishes to delete a document, the user selects the intended document and drags it over to a trash can. In doing this, the user is directly manipulating the item that they wish to do something with. A more generic description for a GUI is the part of a computer program that handles the input from the user and the output to the display (Machiraju, 1996).

Most definitions of GUIs focus on the way the user inputs things into the system, rather than the items displayed on the screen (Draper, 1996). How a user interface presents information to the user is also of importance. For example, word processors generally present text to users as a printed page. Therefore, a system's interface style can refer to both the system's input and the output styles. Most computer applications attempt to give users many different ways to view and manipulate complex data. The user interface attempts to provide a way to make the complexity level more manageable (Machiraju, 1996). For purposes of this study, interface style refers to both the input and output of a system.

Interface style (Draper, 1996) means a constellation of standard solutions to the problem of doing input and output—the look and feel of an interface. Styles differ in their direct effect on users: on the learning burden, the degree of visibility, the degree of interactivity, and on whether the physical equipment is large enough or fast enough to support them. It is the look and feel of the interface, or the interface's style that this study examines to determine if the user interface has an effect in a CSCW environment.

Usability

A subset of HCI is the area of usability that focuses on how different characteristics of a computer interface can affect how a user likes, or dislikes, a particular interface (Davis, 1989; Gefen & Straub, 2000; Gray & Draper, 1997; Morris & Dillon, 1997; Nielsen & Phillips, 1993; Shaw, 2002). When users make decisions about systems, their decision depends not only on usability but on an assessment of things beyond the system; whether they feel the system is suitable for their needs, how much it will cost, both financially, and in terms of the personal, social and organizational consequences, etc. Although a system's usability is important, it cannot be considered in isolation from other those things that are happen outside the computer system (Shackel, 1988). Good system design depends on looking at the dynamic interaction of the four principal components of any user system situation: user, task, tool and environment (Bennett, 1979; Eason, 1982).

The different effects on the user can directly impact the user's perception of the computer system's usability. In general, HCI researchers (Card et al., 1983; John M. Carroll & Thomas, 1982; Norman, 1990) measure ease of use in terms of task timings and error rates. However, objective measures may, or may not, indicate whether the end user actually believes that the computer system is easy to use (John M. Carroll et al., 1988). Since studies (Agarwal & Prasad, 1999; Al-Gahtani & King, 1999; John M. Carroll, 1997; Dasgupta et al., 2002; Davis et al., 1992; Hubona & Geitz, 1997) indicate that if users think positively about a system they will use it more frequently, it is important to discover how users perceive different interfaces. This study examines this question by using a more subjective form of evaluation to determine the overall acceptance rate of a computer interface for a collaborative system.

Computer Supported Cooperative Work Environments

In the mid-1970's, an early use of technology to support group work was referred to as *office automation*. This method relied on minicomputers and single-user applications such as word processors to provide a means for sharing information by a group. However, office automation relied more on technology than on how people worked within a group or specific location. As a result, office automation while successful for a period began to struggle (Grudin, 1994)

The term computer-supported cooperative work (CSCW) was first used at a workshop organized by Peter Cashman and Irene Grief in 1984 (Grudin, 1994). At this workshop, researchers from various disciplines were brought together to share their ideas on how people worked, and how technology could be used to enhance that work. Another term often used is *groupware*, which was coined by Peter and Trudy Johnson-Lenz's to describe technology whose focus is on small organizational units (Grudin, 1991).

The two features that distinguish CSCW systems from other types of systems are the mode of interaction and the geographical location of the users (Ducksworth, 2001).

The system's mode of interaction can be either asynchronous (that is, occurring at different times) or synchronous (that is, occurring at the same time). On the other hand, geographical distribution refers to where the participants are located. The term local is applied to users that are co-located in the same environment, whereas remote means that the people are in different locations. Most developers of collaborative software generally agree on using this time and place framework (see Figure 2) to describe their systems. While these categories are distinct, actual groupware applications can be placed in more than one category. For example, a teleconferencing system is generally classified as a same time/different place application, but it may support a recording system that allows team members to review the meeting at a later or different time (Grudin, 1994).

PLACE \ TIME	Same	Different but predictable	Different and unpredictable
Same	Meeting facilitation	Work shifts	Team rooms
Different but predictable	Teleconferencing Videoconferencing Desktop conferencing	Electronic mail	Collaborative writing
Different and unpredictable	Interactive multicast seminars	Computer bboards	Workflow

Figure 2. Types of CSCW systems. (© 1994 IEEE, used with permission)

The CSCW system that this study examines falls into the area of *same time, and different but predictable* area of the table. The system provides synchronous communication, and supports both local and remote groups.

Research within the field of CSCW has taken many paths since the field's inception in 1984. CSCW systems that allow task and information sharing among groups have been created to include systems that allow multiple users to work in real-time on the same document (Greenberg & Gutwin, 1998), conduct real-time team meetings (Prabhakar, 1999; Roseman & Greenberg, 1996), and participate in distance courses (Collings & Walker, 1999; White et al., 2000). Along with the CSCW system development, studies focusing on the network itself have been done to determine the impact on user acceptance of the CSCW system (Conner & Holden, 1999). Other areas of study include what type of tools should be used to support collaboration. Tools such as video conferencing systems, email, application sharing, and electronic whiteboards have been done to assess the effectiveness of these tools (Ellis & Wainer, 1994; Wolf et al., 1995). Research has also been directed at the user by identifying how to improve work processes in a collaborative system and by determining the most effect use of the technology to improve the quality of work (Greenberg et al., 1995).

Another area being studied within CSCW is the underlying architecture of the system. Reinhard et al. (1994) have shown that peer-to-peer architectures work best in large networks because of the large number of workstations, while client-server architectures work best for small centralized networks.

CSCW research has also focused on improving the user interface. For example, (Frivold et al., 1999; Somers et al., 1999) examined the use of the World Wide Web and hypertext as the means for collaboration. Other studies have focused on user awareness and how to show users what activity is being done and by which users (Greenberg, 1999; Gutwin & Greenberg, 1998). This study also looks at the user interface in a CSCW environment and how users perceive its usefulness.

Computer Experience

Computer self-efficacy has become an important factor in determining whether a technology will be accepted. The term computer self-efficacy may be defined as "a judgment of one's ability to use a computer" (Compeau and Higgins, 1995, p. 192). M. Igbaria and Iivari (1995) believe that self-efficacy is associated with beliefs and behavior, and that it has a critical influence on decisions involving computer usage and adoption. Morris and Turner (2001) argued that "people who believe they are capable of using IT to accomplish their tasks are more likely to use IT than those who do not share similar self-efficacy beliefs" (p. 882). Venkatesh and Davis (1994) verified that users' perceived ease of use is strongly associated with computer self-efficacy in the early stages of technology acceptance. As a result, self-efficacy studies often include computer experience as a control factor or as an antecedent of self-efficacy. In a study by Taylor and Todd (1995), which examined the role of prior experience on information technology (IT) usage, the results suggest that there are some significant differences in the relative influence of the determinants on IT usage depending on experience. Hoxmeirer et al. (2000) noted that people who have had positive experiences with computers are likely to look for new ways to use them.

A variety of methods for assessing computer use and computer experience has been examined by researchers. For example, Wu and Morgan (1989) identified several applications for which college students appear to use computers including information retrieval, data analysis, programming, word processing, creating graphics and communication. In a review of the literature on computer use, Mitra (1998) outlined three ways of categorizing computer use by evaluating the usage criteria of: temporality, the issue of instruction, and the specific software and applications that are being used. Some studies have included all three categories of criteria. One study, Magid Igabaria et al. (1995), integrated the elements of temporality, instruction, and application into their research model using TAM to test the determinants of microcomputer usage. Computer experience was measured on a self-report Likert-type scale as extent of experience using 5 different generic types of software and languages (where 1 = none and 5 = extensive). Their findings recognized that computer use or computer experience can have various manifestations.

B. Smith et al. (1999) report, in a review of current definitions and methods used to assess computer experience, that most of the studies reviewed adopted measures that assess what they termed objective computer experience, rather than subjective computer experience. They define objective computer experience as “the totality of external observable, direct and /or indirect human-computer interactions which transpire across time” (p.229), and subjective computer experience as “a private psychological state reflecting the thoughts and feelings a person ascribes to some existing computing event” (p. 230). They believe that researchers have still not devised a reliable and valid measure of the conceptualized subjective computer experience.

Levels of Computer Experience

Studies have been conducted with the technology acceptance model as the research model using levels of computer experience as one of the external variables. Magid Igabaria et al. (1995) showed that computer experience influenced perceived usage and variety of use directly as well as indirectly through perceived ease of use and perceived usefulness. A study by Al-Gahtani and King (1999) introduced several new variables, including user characteristics and end-user computing satisfaction. The study assessed computer experience using five items to which respondents indicated their years of experience in using computers, writing computer programs and using similar packages, as well as their current skill level with various packaged application software. Results showed only a significant link from computer experience to attitude about system usage; links to perceptions of ease of use and usefulness were not supported.

Agarwal and Prasad (1999) examined the relationship between individual differences and information technology acceptance. Their study analyzed the constructs of the technology acceptance model and assessed prior familiarity with similar technologies using three items: level of familiarity with personal computers, prior usage of GUIs, and prior usage of input devices such as mice and joysticks. Their results showed that prior experience with similar technologies had a positive association with ease of use only.

Technology Acceptance Model

Davis (1989) developed the technology acceptance model (TAM) to provide a more general explanation for the determinants of computer acceptance, which was capable of explaining user behavior across a broad range of end-user computing technologies and user populations (Money & Turner, 2004). TAM is based on a broad theoretical framework which includes adoption of innovations, the cost-benefit paradigm, expectancy theory, and self-efficacy theory (Davis, 1989). The TAM model is presented in Figure 3.

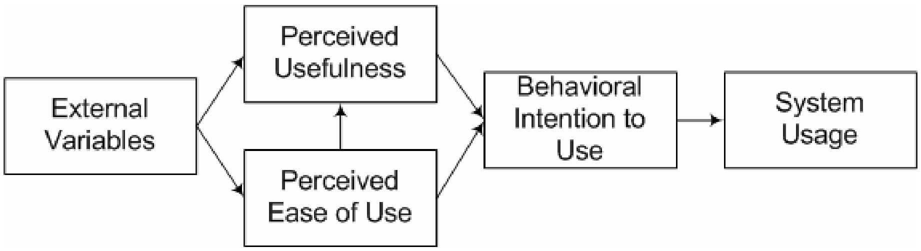


Figure 3. Technology acceptance model. (Copyright © 1989 by the Regents of the University of Minnesota. Used with permission)

According to TAM, a user's acceptance of technology is dependent on two types of users' perceptions. Perceived ease of use (PEOU) refers to the user's perception of the amount of effort needed to use the system, and perceived usefulness (PU) relates to the user's perception of the degree to which using the system will improve his or her performance in the workplace (Davis, 1989; Davis et al., 1992). Users' intentions have also been found to be better predictors of system usage than competing predictors such as realism of expectations, motivational force, value, user information satisfaction and user involvement, and user satisfaction (Venkatesh & Davis, 1996).

The technology acceptance model (TAM) has been used frequently to obtain a more subjective measure of a computer system's acceptance by end users. The result is a significant body of research that has confirmed TAM's usefulness as a tool for investigating and predicting user acceptance of information technology (Taylor and Todd, 1995). Szajna (1996) confirmed that TAM was an objective measure of technology acceptance. Similarly, Geffen & Straub (1997) assessed PEOU's role in determining its affects on information technology acceptance.

Within the body of research using TAM, there are several studies that focus on its use with collaborative systems. Dasgupta, Granger and McGarry (2002) used TAM to evaluate an e-collaboration tool designed to assist with the delivery of courses via the Internet. The system allowed instructors to post course outlines, schedules, and lecture notes for students. The results of their study showed that TAM could be used to analyze the acceptance of e-collaborative systems used in education. Yager (1999) analyzed firms that had virtual project teams using group decision support systems (GDSS) as a tool to facilitate project meetings. The GDSS supported presentation software, calendaring, group-authoring, and group memory functions. Yager reports that virtual project teams had a higher PEOU, PU, and intention to use regarding IT support mechanism than non-virtual project teams. In a study by Laitenberger and Dreyer (1998), a Web-based inspection process support tool (WIPS) was developed for inspection of different data collection mechanisms. They then used TAM to evaluate the tool. Their findings confirmed the reliability and validity of TAM. Yoo (1998) performed a longitudinal study evaluating groupware acceptance. The groupware tools used in this study included email, shared document storage, threaded discussion, and workflow automation. Yoo's results suggest that there are external influences on technology acceptance of groupware and that more research in this area needs to be conducted.

There have been several studies that confirm the validity of the TAM as a tool for predicting technology acceptance. Adams (1992) examined TAM using five different applications and found that TAM maintained its consistency and validity in predicting acceptance behavior. Davis (1993) replicated his previous study (Davis et al., 1992) using two different technologies and found that TAM explained the adoption of both systems. Subramanian (1994) performed the replication of the original TAM with two mail systems and found that TAM variables showed results consistent with previous studies.

In addition to those studies cited above, TAM has undergone rigorous testing. Adams (1992) replicated the original Davis 1989 study and found the measures for both PU and PEOU to be valid and reliable across different settings and different information systems. Hendrickson et al. (1993; 1996) examined the test-retest reliability of the PU and PEOU scales and found the TAM instruments to be reliable and valid in terms of test-retest analysis. Szajna (1994) investigated the TAM variables to determine if they could successfully predict future behavior. Szajna found that both PU and PEOU had good predictive validity. Studies have extensively investigated whether TAM instruments were powerful, consistent, reliable, and valid and they found these properties to hold (Lee et al., 2003).

Summary

This chapter presents an overview of the important ideas that were relevant for this the research presented in this dissertation. These ideas were synthesized from the significant theoretical constructs identified in an extensive analysis of the current literature. The breadth and depth of this analysis, and the resulting summaries, made the theoretical product of this chapter a powerful tool for guiding this study. The importance of this study has been helped through the extensive analysis of each of the following domains of current literature: human-computer interaction, usability, computer-supported cooperative work, computer experience, and the technology acceptance model (TAM).

The general question that was faced is what affects the acceptance of a computer-supported collaborative environment. The main examples of how to approach this problem were discussed in great detail in the literature described above. These areas have contributed in greater or lesser degrees to the design of this study.

CHAPTER 3

METHODOLOGY

Introduction

This chapter reviews the research and design methodology that was used to answer the research questions posed in Chapter 1. First, a description of the collaborative software system that was used is discussed. This is followed by a review of the setting and selection of study subjects.

Collaborative Software System

The collaborative software selected for this project was developed as part of a Fund for the Improvement of Post-Secondary Education (FIPSE) research project (Swigger, 1996). The software was named the Virtual Collaborative University, or VCU. The VCU system is an Internet/intranet based collaborative system that supports the following components:

1. Individual chat, which allows two individuals connected to the system to have a one on one discussion,
2. Group chat, which allows multiple group members to talk with other group members who are logged in,
3. Shared whiteboard, which allows individuals, or group members, to load images and draw items on the display which can then be viewed by other individuals, or group members,
4. Directed Web browsing, which allows one group member to lead other group members on a Web browsing tour,

5. Application sharing, which allows group members to use an application running on one group member's workstation while providing all group members the ability to control the application remotely and have access to the application's content, and
6. File sharing, which allows group members to send and receive files from other group members.

Neither audio nor video conferencing were included in VCU because both have significant bandwidth requirements which would have required subjects to have high-speed broadband connections available to them while using the system, which was not available to everyone in the broader study.

All the components of the VCU system support real-time synchronous communication. The system uses a peer-to-peer architecture in which each system running VCU acts as both a server for distributing packets of information and a client in accepting and processing the packets of information. Figure 4 diagrams the peer-to-peer architecture of VCU. Initially, each system contacts a central server to get the list of available systems within the peer-to-peer network of systems. Once the group is connected, there is no other communication through the server except to send usage results at the end of the session.

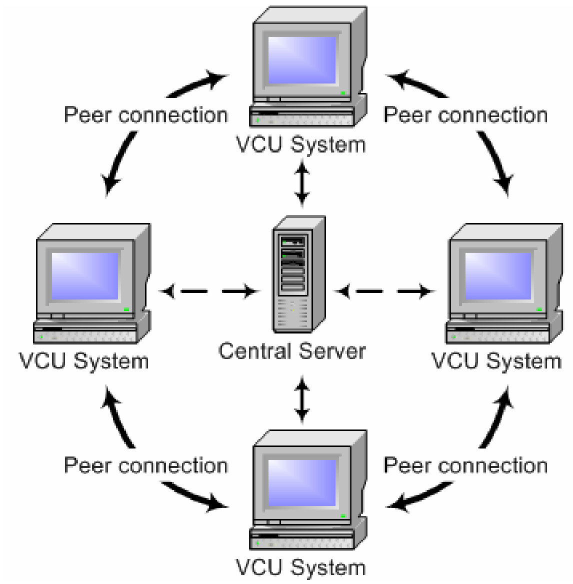


Figure 4. VCU peer-to-peer architecture.

Two distinct user interfaces were developed for the VCU system. The first interface (interface 1 - see Figure 5), provides the user with a loosely associated display that appears as multiple applications controlled by a central *command center* application. This interface displays all of the components listed above, but as individual applications. Starting from the upper left-hand corner of Figure 5 and moving clockwise, the components are: individual chat, shared whiteboard, group chat, shared Web browsing, and the command center is in the center. The application sharing and file sharing components are not shown, but were included in the system. The user starts these applications started by selecting the appropriate button on the command center component's interface.

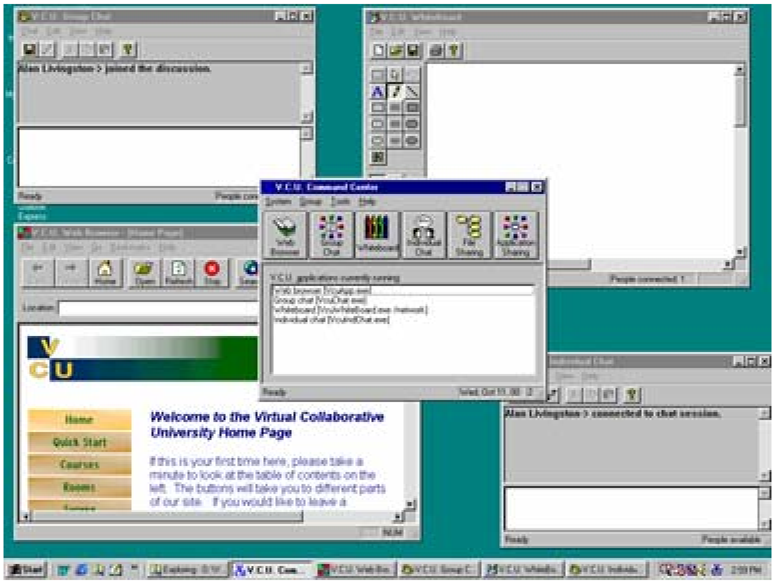


Figure 5. Interface 1.

The second interface, (i.e., interface 2 - see Figure 6), provides the user with a single application. This interface provides the same set of components as interface 1, except they appear within a single window. The window is divided into different work areas. The chat utility is at the top of the window and has an area to type the message and send to a list of individuals, or groups of individuals. The chat utility also has a place to view messages that are received from other users of the VCU system. Just below the chat utility, on the left-hand side of the application is the command center of this interface. It provides a series of icons that when clicked activate the appropriate utility. The selected components are displayed within individual windows on the right-hand side of the command center. The application sharing and file sharing components are not shown, but were included in the system. They are started by selecting the appropriate button on the command center component's interface.

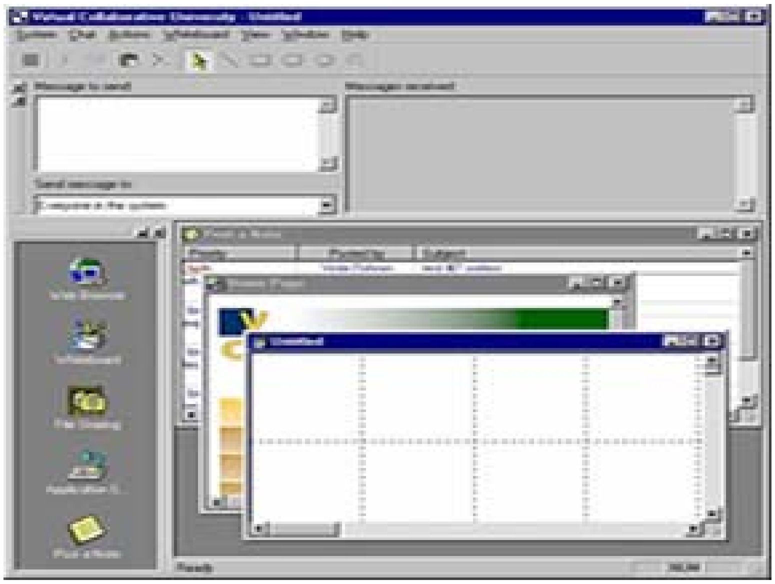


Figure 6. Interface 2.

Study Setting

The study setting was designed to simulate the use of an Internet based collaborative system by distributed groups. The VCU system was available in multiple computer laboratories throughout the University of North Texas campus. The software could also be downloaded from the VCU website and installed on a student's home computer. The system requirements for installing the VCU system were a personal computer running the Windows® 95 (Microsoft Corporation, http://www.microsoft.com) operating system. The computer also needed to be able to use the TCP/IP network protocol for communicating with the other VCU enabled computers in the peer-to-peer system.

The central server required for establishing the initial list of computers in the VCU system was housed in the VCU lab. The central server managed the database server that received the usage reports and maintained the active VCU user list and the VCU website. The central server platform was Windows NT Server™ (Microsoft Corporation, http://www.microsoft.com) with SQL Server™ (Microsoft Corporation, http://www.microsoft.com) and Microsoft® (Microsoft Corporation, http://www.microsoft.com) Internet Information Services (IIS) running concurrently.

Research Subjects and Setting

The subjects for this study were students enrolled in computer science, mathematics, geography, library science, communication and educational computing courses at the University of North Texas. Within each course, the subjects were divided into groups. Each group was comprised of two to four members depending on the course and the task that was to be accomplished for that course. The subjects were randomly assigned to a group within each course. The experimental design portrays a subject pool that is similar to a virtual organization because subjects were drawn from multiple courses, could use the system in multiple locations and could work together to accomplish a specific project or task.

The subjects were trained on how to use the collaborative software and were given a practice session in which the subjects were placed in the same room and asked to use the computer-supported collaborative software with someone else in that same room. Since the subjects were in the same room, they could quickly troubleshoot problems with the VCU system in a non-task setting. The training materials consisted of:

1. A Fund for the Improvement of Post-Secondary Education (FIPSE) Virtual Collaborative University (VCU) Consent to Participate Form, which informed the participants about the project and asked them to sign a consent form giving the researchers permission to use their data.

2. An Introduction to the Virtual Collaborative University, the handout provided students with information on how to access the system, which applications were available in the system, and how to request technical support.
3. About the VCU Tools, a multiple page handout that provided information about each of the tools available in the system and how to use them.
4. Saving Images From the Internet for Use example, this handout was provided to assist subjects that needed to place images on the shared whiteboard as part of their assignment.
5. Quick Steps for File and Application Sharing example, this handout provided subjects with instructions on how to establish file sharing or application sharing and a few guidelines on how to manage the sharing process.

6 Tips for Teaming: Working Together, a handout that provided information about how to work and learn in cooperative groups.

The VCU software training session and materials were given to all subjects. See Appendix A for the training materials that were used during these practice sessions.

After the training and practice sessions were finished, the subjects were asked to complete the task that was assigned by their instructor. After the subjects finished these tasks they were then asked to complete a questionnaire, which collected both demographic and VCU technology related data.

Tasks for this Study

Since the focus of this study was on the users' perceptions of different interface styles as affected by a subjects' level of experience with other software applications, the type of tasks that the subject performed was not critical to the goal of the study. The various tasks that were performed illustrated a wide variety of collaborative situations. Several tasks required the subject groups to work together to solve a common problem. For example, the task for the mathematics course required subjects to work as a group to answer the following:

1. A man and a woman are standing side by side with their weight on their right feet. They begin by walking so that each steps out on his or her left foot. The woman takes three steps for each two steps of the man. How many steps does the man take before their right feet simultaneously reach the ground?
2. In this problem only one statement is true. Determine from the information given who did it?
   - A said, “B did it.”
   - B said, “D did it.”
   - C said, “I did not do it.”
   - D said, “B lied when he said I did it.”

Additionally, the geography course required teams to identify weather features in the general circulation from images found on the Internet.

Other tasks such as the library science course task involved subject groups searching for information individually and then discussing the collected information as a group. The library science course subjects evaluated federal statistical websites using a set of guidelines and then as a group created an evaluation report of the websites they visited to be presented at the next class meeting.

All of the tasks utilized the components within the system so that the subjects would be exposed to the two interface styles of the system. See Appendix B for a sampling of tasks that were completed by the subjects.

Research Instrument

The research instrument used in this study is reproduced in Appendix C. The research constructs and the source of the scales used are shown in Table 2. The technology acceptance questions used were derived from these scales by changing the system terminology, where appropriate, to match the VCU system. For example, the technology acceptance questions on the instrument used terms associated with the VCU system such as collaborative software instead of the name of a different software application.

Table 2

Research Construct and Source of Scales/Measures

Scale	Source
Perceived Ease of Use	Davis, 1989
Perceived Usefulness	Davis, 1989
Use of Internet Based Software	Davis, 1989

Overview of Statistical Techniques

A variety of statistical techniques were used to assess the research model and test the research hypotheses. All of the statistical techniques were carried out using the SAS® System for Windows (SAS Institute, Inc., http://www.sas.com). The techniques used included Pearson coefficient correlations, Spearman correlations, one-way analysis of variance, principal component analysis, and multiple regression analysis. The principal component analysis was used to assess the validity of the scales used and the coefficient alpha (Cronbach, 1951) was used to assess the reliability. The statistical analysis of the data is presented in Chapter 4.

CHAPTER 4

DATA ANALYSIS AND RESULTS

Introduction

This chapter describes the sample collected for analysis, outlines the steps taken to analyze the sample, and then presents those results. The analysis begins with a principal component analysis to verify that the questionnaire used for data collection is consistent with the technology acceptance model (TAM) questionnaire (Davis, 1989) and that the components of perceived usefulness (PU) and perceived ease of use (PEOU) load appropriately. Following this, results for each of the hypothesis are reported.

Sample

The sample was a sample of convenience drawn from students enrolled in courses at the University of North Texas who agreed to participate in the Fund for the Improvement of Post-Secondary Education (FIPSE) funded Virtual Collaborative University (Swigger, 1996) research project. The sample includes both undergraduate and graduate students studying in the following areas: mathematics, computer science, education, library science, communications, and geography. Three hundred and thirty-one subjects participated in this study. In order to be considered usable data within this study's sample, each subject must have completed both the demographic and technology acceptance questionnaire. After removing subjects that had not completed both questionnaires, there were 200 useable samples, 100 hundred subjects using interface 1 and 100 subjects using interface 2. Of the two hundred subjects, 101 were women and 99 were men.

Internal Consistency

Before administering the principal component analysis the coefficient alpha was computed to determine the internal consistency reliability of the scale used on the technology acceptance questions. A reliability coefficient may be defined as the percent of variance in an observed variable that is accounted for by true scores on the underlying construct (Hatcher & Stepanski, 1994). The internal consistency is the extent to which the individual items that constitute a test correlate with one another or with the test total. In the social sciences, the index used to measure internal consistency reliability is the coefficient alpha (Cronbach, 1951). Coefficient alpha reliability estimates (Cronbach, 1951) all exceed .70, and are reported on the diagonal of Table 3. This coefficient exceeds the minimum value of .70 recommended by Nunnally (1978).

Table 3

Means, Standard Deviations, Intercorrelations, and Coefficient Alpha Reliability Estimates for the Study's Variables

				Intercorrelations							
Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Question 1	3.44	1.29	(73)								
2. Question 2	2.75	1.33	23	(77)							
3. Question 3	2.79	1.34	43^{***}	22^{**}	(71)						
4. Question 4	2.98	1.49	-6	23^{**}	-16^{*}	(82)					
5. Question 5	3.43	1.45	46^{***}	4	48^{***}	-10^{***}	(73)				
6. Question 6	1.88	1.14	5	33^{***}	20^{*}	29^{**}	63	(77)			
7. Question 7	2.76	1.30	46^{***}	18^{**}	74^{***}	-24^{**}	53^{***}	17^{*}	(71)		
8. Question 8	3.27	1.48	38^{***}	12	60^{***}	-19	54^{***}	11	62^{***}	(72)	
9. Question 9	2.70	1.33	48^{***}	12	67^{***}	-17	46^{***}	11	71^{***}	65^{***}	(71)

Note. *N* = 200. Decimals omitted from correlations and coefficient alpha reliability estimates.
* $p < .01$, ** $p < .001$, *** $p < .0001$

Principal Component Analysis

Prior to evaluating the research hypotheses, a principal component analysis was done on the technology acceptance questionnaire to verify that it was consistent with the TAM questionnaire format. The primary purpose of this verification was to extract the factors of PU and PEOU.

Responses to the 9-item questionnaire were subjected to a principal component analysis using ones as prior communality estimates. The principal axis method was used to extract the components, and this was followed by a varimax (orthogonal) rotation.

Only the first two components displayed eigen values greater than 1, and the results of a scree test also suggested that only the first two components were meaningful. Therefore, only the first two components were retained for rotation. Combined, components 1 and 2 accounted for 61% of the total variance.

Questionnaire items and corresponding factor loadings are presented in Table 4. In interpreting the rotated factor pattern, an item was said to load to a given component if the factor loading was .40 or greater for that component, and was less than .40 for the other. Using these criteria, six items were found to load on the first component, which was subsequently labeled the perceived ease of use (PEOU). Three items also loaded on the second component, which was labeled the perceived usefulness (PU) component.

Table 4

Rotated Factor Pattern and Final Communality Estimates from Principal Component Analysis of Technology Acceptance Model

Component			
1	2	h^2	Items
.65	.06	.43	1. Technology enhanced my ability to learn the material.
.25	.70	.55	2. I found the use of multiple tools to be overwhelming.
.85	.05	.71	3. The use of the collaborative software was valuable to my learning in this class/completion of this project.
-.22	.72	.57	4. I spent too much time trying to learn to use the collaborative software.
.70	-.12	.51	5. I could use technology that I learned for this project outside the context of this class.
.20	.73	.58	6. I was at a disadvantage in this project because I do not possess adequate computer skills.
.87	-.04	.76	7. Because of the collaborative software I was better able to visualize the ideas and concepts that were taught in the course.
.80	-.09	.65	8. Chat helped me communicate with other students in the class about the project.
.84	-.07	.71	9. Because of the collaborative software, I enjoyed this course more than I would have otherwise.

Note. N = 200. Communality estimates appear in the column head h^2.

Once the component analysis had been completed, scores were assigned to each subject to indicate where that subject ranked in relation to the retained components. The assigned scores were factor-based scores, which is a linear composite of the variables that demonstrated meaningful loadings for the components in questions, PU and PEOU. The factor-based score for PU was created by adding the subject's responses to items 2, 4, and 6. The factor-based score for PEOU was created by adding the subject's responses to items 1, 3, 5, 7, 8, and 9.

Analysis for Hypothesis 1

Hypothesis 1: Interface style has an effect on a user's perceived ease of use of a collaborative technology.

In order to determine if interface style has an effect on the perceived ease of use, a one-way ANOVA, between-groups design was created. The predictor variable used was version of the interface, which was measured on a nominal scale and could assume two values: interface 1 (coded as a 1) and interface 2 (coded as a 2). The criterion variable represented subjects' PEOU of the system. The PEOU variable was the factor-based score created from the principal component analysis.

Table 5

ANOVA Summary Table for H1: Interface Style's Effect on Perceived Ease of Use

Source	*df*	*SS*	*MS*	*F*	R^2
Version of Interface	1	444.02	444.02	11.20*	.05
Within Groups	198	7849.1	39.64		
Total	199	8293.12			

Note. *N* = 200.
* $p < .001$

Results were analyzed using a one-way ANOVA, between-groups design. This analysis revealed a significant effect for the version of interface, $F(1,198) = 11.20$; $p < .001$. The sample means are displayed in Table 5. Tukey's HSD test showed that subjects using version 2 of the interface scored higher on PEOU than subjects using version 1 of the interface.

Analysis for Hypothesis 2

Hypothesis 2: Level of experience using different software applications has an effect on a user's perceived ease of use of a collaborative technology.

Subjects were asked to rate their level of software experience. This subjective measure was obtained by asking subjects to self-rank themselves on a scale of 1 to 5, with 1 Indicating that they had never used that type of application software and 5 indicating that they were thoroughly familiar with that type of application software. A frequency analysis is shown in Table 6 for the results of the self-assessed level of experience.

Table 6

Level of Experience Frequency by Type of Application Used

Type of Application	Never Used	Level I	Level II	Level III	Level 4
Word Processing	0	10	26	45	88
Spreadsheet	13	35	46	40	32
Database	20	46	36	32	25
Presentation Graphics	31	43	24	36	28
Email	7	9	21	58	71
Web Browser	6	10	27	59	64
FTP	78	11	23	24	18
Overall Skill[a]	10	21	63	58	17

Note. Not all categories reflect $N = 200$ due to non-responses on some categories.
[a] Overall Skill was calculated by summing all other categories: word processing, spreadsheet, database, presentation graphics, email, Web browser, and FTP and dividing by the number of categories to create an individual subject's overall rating.

Results were analyzed using both bivariate correlation and multiple regression. Means, standard deviations, Pearson correlations and coefficient alpha reliability estimates appear in Table 7. The bivariate correlations revealed no predictor variables that were significantly related to PEOU. All correlations to PEOU were outside of an acceptable range, $p < .05$.

Table 7

Means, Standard Deviations, Intercorrelations, and Coefficient Alpha Reliability Estimates

			Intercorrelations								
Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. PEOU	18.38	6.46	(87)								
2. Word Processng	3.59	1.76	8	(63)							
3. Spreadsheet	2.71	1.65	4	78*	(64)						
4. Database	2.37	1.66	3	71*	80*	(64)					
5. Presentation	2.37	1.70	4	67*	77*	70*	(64)				
6. Email	3.38	1.82	9	84*	77*	72*	73*	(62)			
7. Web Browser	3.32	1.79	13	81*	71*	67*	71*	87*	(63)		
8. FTP	1.78	1.64	1	52*	57*	53*	60*	61*	64*	(66)	
9. Overall Skill	2.79	1.52	8	88*	87*	84*	86*	91*	89*	71*	(63)

Note. $N = 200$. Decimals omitted from correlations and coefficient alpha reliability estimates. Reliability estimates appear on the diagonal.
* $p < .0001$

Using multiple regression, PEOU scores were then regressed on the linear combination of all level of experience values. The equation containing these eight variables was not significant, $F(8, 191) = .80$, $p < .6$, adjusted $R^2 = -.0083$.

The bivariate correlation multiple regression did not show any predictors with a significant effect on PEOU, Beta weights (standardized multiple regression coefficients) and uniqueness indices were calculated for completeness. The uniqueness index for a given predictor is the percentage of variance in the criterion accounted for by that predictor, beyond the variance accounted for by the other predictor variables. Beta weights and uniqueness indices are presented in Table 8. The table shows no significant beta weights. The findings regarding uniqueness indices matched those for beta weights, in that no value displayed significant indices.

Table 8

Beta Weights and Uniqueness Indices Obtained in Multiple Regression Analyses Predicting PEOU

	Beta Weights[a]		Uniqueness Indices[b]	
Predictor	Beta	*t*[c]	Uniqueness Index	*F*[d]
1. Word Processing	-.11	-.63	.002	.41
2. Spreadsheet	-.05	-.30	.001	.1
3. Database	-.11	-.78	.003	.61
4. Presentation Graphics	-.11	-.74	.003	.55
5. Email	-.04	-.22	0.00	.06
6. Web Browser	.21	1.22	.008	1.5
7. FTP	-.15	-1.31	.009	1.74
8. Overall Skill Level	.36	.83	.004	.69

Note. N = 200.
[a] Beta weights are standardized multiple regression coefficients obtained when PEOU was regressed on all eight predictors. [b] uniqueness indices indicate the percentage of variance in PEOU scores accounted for by a given predictor variable beyond the variance accounted for by the other seven predictors. [c] for t tests that tested the significance of the beta weights df = 191. [d] for F test that tested the significance of the uniqueness indices df = 1, 191.

Analysis for Hypothesis 3

Hypothesis 3: Interface style has an effect on a user's perceived usefulness of a collaborative technology.

In order to determine if interface style has an effect on the perceived usefulness of collaborative software, a one-way ANOVA, between-groups design was created. The predictor variable used was version of the interface which was measured on a nominal scale and could assume two values: interface 1 (coded as a 1) and interface 2 (coded as a 2). The criterion variable represented subjects' PU of the system. The PU variable was the factor-based score created from the principal component analysis.

Table 9

ANOVA Summary Table for H3: Interface Style's Effect on Perceived Usefulness

Source	*df*	*SS*	*MS*	*F*	R^2
Version of Interface	1	2.42	2.42	.29	.002
Within Groups	198	1629.58	8.23		
Total	199	1632.0			

Note. *N* = 200.
* *p* < .001

Results were analyzed using a one-way ANOVA, between-groups design. This analysis did not reveal any significant effect for the version of interface, $F(1,198) = .29$; $p < .59$. The sample means are displayed in Table 9.

Analysis for Hypothesis 4

Hypothesis 4: Level of experience using different software applications has an effect on a user's perceived usefulness of a collaborative technology.

Results were analyzed using both bivariate correlation and multiple regression. Means, standard deviations, Pearson correlations and coefficient alpha reliability estimates appear in Table 10. The bivariate correlations revealed three predictor variables that were significantly related to PU: Presentation (r = -24), FTP (r = -16), and Overall Skill (r = -16). The Presentation correlation was significant at $p < .001$, while FTP and Overall Skill were significant at $p < .05$. All other correlations to PU were outside of the acceptable range, $p < .05$.

Table 10

Means, Standard Deviations, Intercorrelations, and Coefficient Alpha Reliability Estimates

			Intercorrelations								
Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. PU	18.38	6.46	(75)								
2. Word Processng	3.59	1.76	-4	(63)							
3. Spreadsheet	2.71	1.65	13	78^{***}	(64)						
4. Database	2.37	1.66	-9	71^{***}	80^{***}	(64)					
5. Presentation	2.37	1.70	-24^{**}	67^{***}	77^{***}	70^{***}	(64)				
6. Email	3.38	1.82	-6	84^{***}	77^{***}	72^{***}	73^{***}	(62)			
7. Web Browser	3.32	1.79	-10	81^{***}	71^{***}	67^{***}	71^{***}	87^{***}	(63)		
8. FTP	1.78	1.64	-16^{*}	52^{***}	57^{***}	53^{***}	60^{***}	61^{***}	64^{***}	(66)	
9. Overall Skill	2.79	1.52	-16^{*}	88^{***}	87^{***}	84^{***}	86^{***}	91^{***}	89^{***}	71^{***}	(63)

Note. *N* = 200. Decimals omitted from correlations and coefficient alpha reliability estimates.
* $p < .05$, ** $p < .001$, *** $p < .0001$

Using multiple regression, PU scores were then regressed on the linear combination of all levels of experience values. The equation containing these eight variables accounted for 12% of the variance in PU, $F(8, 191) = 3.25$, $p < .001$, adjusted $R^2 = .083$.

Beta weights (standardized multiple regression coefficients) and uniqueness indices were then reviewed to assess the relative importance of the eight variables in the prediction of PU. The uniqueness index for a given predictor is the percentage of variance in the criterion accounted for by that predictor, beyond the variance accounted for by the other predictor variables. Beta weights and uniqueness indices are presented in Table 11.

The table shows that only Email and Overall Skill displayed significant beta weights. Overall Skill demonstrated a somewhat larger beta weight at -.84 ($p < .05$), while the beta weight for Email was .38 ($p < .05$).

The finding regarding uniqueness indices matched those for the beta weights, in that only Email and Overall Skill displayed significant indices. Email accounted for approximately 2% of the variance in PU, beyond the variances accounted for by the other eight predictors, $F(1, 191) = 4.58$, $p < .05$. Additionally, Overall Skill accounted for approximately 2% of the variance of PU as well, this was also beyond the variances accounted for by the other eight predictors $F(1,191) = 4.58$, $p < .05$.

Table 11

Beta Weights and Uniqueness Indices Obtained in Multiple Regression Analyses Predicting PEOU

	Beta Weights[a]		Uniqueness Indices[b]	
Predictor	Beta	t[c]	Uniqueness Index	F[d]
1. Word Processing	0.32	1.93	.017	3.73
2. Spreadsheet	0.02	0.15	0.00	0.02
3. Database	0.21	1.51	.010	2.26
4. Presentation Graphics	-0.21	-1.45	.010	2.08
5. Email	0.38*	2.14	.021	4.58
6. Web Browser	0.02	0.14	0.00	0.02
7. FTP	0.03	0.25	0.00	0.07
8. Overall Skill Level	-0.84*	-2.01	.019	4.01

Note. $N = 200$.
[a] Beta weights are standardized multiple regression coefficients obtained when PEOU was regressed on all eight predictors. [b] uniqueness indices indicate the percentage of variance in PEOU scores accounted for by a given predictor variable beyond the variance accounted for by the other seven predictors. [c] for t tests that tested the significance of the beta weights $df = 191$. [d] for F test that tested the significance of the uniqueness indices $df = 1, 191$.
* $p < .05$

Results Summary

The summary of hypotheses is shown in Table 12.

Table 12

Summary of Hypotheses

Hypothesis	Statement
H1: (accept)	Interface style has an effect on a user's perceived ease of use of a collaborative technology.
H2: (reject)	Level of experience using different software applications has an effect on a user's perceived ease of use of a collaborative technology.
H3: (reject)	Interface style has an effect on a user's perceived usefulness of a collaborative technology.
H4: (accept)	Level of experience using different software applications has an effect on a user's perceived usefulness of a collaborative technology.

From the preceding analysis, it is clear that the interface style does have an effect on the subject's perceived ease of use of the system being analyzed. *The implication is to accept hypothesis 1: Interface style has an effect on a user's perceived ease of use of a collaborative technology.* This would seem consistent with the idea that as subjects are introduced to a new application, it is the interface style that the user reacts to first. The analysis also shows that interface 2 had a higher level of acceptance as it relates to perceived ease of use than interface 1. This was indicated by the Tukey HSD test analysis of hypothesis 1.

However, this study also shows that the level of experience using different software application does not have an effect on the subject's perceived ease of use of the system. *The implication is to reject hypothesis 2: Level of experience using different software applications has an effect on a user's perceived ease of use of a collaborative technology.* Again, this seems consistent with the idea that as subjects are introduced to a new application, their level of experience using other applications may not carry over into the CSCW system. The CSCW system requires a user to manage multiple input/output streams simultaneously while most other application environments only require a single input/output stream. For example, in a CSCW system, the user may have to manage a chat session with an individual, a chat session with a group, and an application sharing session, all at the same time. However, in a typical word processing system, the only interaction is through a single source, the word processor itself.

The next analysis was to determine if the interface style has an effect on the subject's perceived usefulness of the system. From the analysis, the interface style had no effect on the perceived usefulness of the system. *The implication is to reject hypothesis 3: Interface style has an effect on a user's perceived usefulness of a collaborative technology.* In the larger scheme this again seems consistent with user perceptions about computers. The interface style should not impact the user's concept of usefulness. A user tends to view usefulness in the context of what the system does and not how it looks. For example, if the user has a need to chat, share applications and files, then they might think the system useful, even if the interface style was overly complex. But, if the user has no need for these types of features, then the interface style would not change their opinion of its usefulness.

The final analysis was to determine if the level of experience using different software applications had an effect on the subject's perceived usefulness of the system. The results indicate that there is an effect. *The implication is to accept hypothesis 4: Level of experience using different software applications has an effect on a user's perceived usefulness of a collaborative technology.* As with the other three hypotheses, this seems consistent. If the user has previous knowledge of different software applications, then their perception of the usefulness of a new application would be biased based on their previous experiences.

CHAPTER 5

CONCLUSION

Introduction

The problem motivating this study was that people who are located in different places need to be able to communicate with one another. One way to do this is by using complex computer tools that allow users to share information, documents, programs, etc. As an increasing number of business organizations require workers to use these types of complex communication tools, it is important to determine how users regard these types of tools and whether they are perceived to be useful. If a tool, or interface, is not perceived to be useful then it is often not used, or used ineffectively. To evaluate the problem, the study applied the technology acceptance model as tool for evaluating style of user interface look and feel in a collaborative environment, and attempted to predict which factors of that model, perceived ease of use and/or perceived usefulness, could lead to better acceptance of a particular style of collaborative tools within an organization. It also tried to determine if a users' previous experience might affect either the perceived usefulness or ease of use of a system,

Findings

In this study, Davis's technology acceptance model was presented as a possible tool for evaluating the perceived usefulness and ease of use of the user interface style in a synchronous collaborative environment. As TAM shows, perceived ease of use and perceived usefulness are important factors in assessing technology acceptance. But, the level of importance in the acceptance process has been shown to vary. In

Davis (1993), usefulness was more apparent than ease of use, Adams (1992) found ease of use to be more influential than usefulness. Agarwal and Prasad (1999) show a more balanced combination of usefulness and ease of use, stating "at the start … the technology is primarily an interface, where ease of use would be an important concern for users" (p. 381). The interface style's impact on perceived ease of use can be further supported by Gefen and Straub (2000) who state that perceived ease of use is "related to assessments of intrinsic characteristics of information technology, such as … clarity of its interface" (p. 8).

The results of this study show that interface style does have an effect on perceived ease of use. It was shown that interface 2 had a higher acceptance level than interface 1. Given the limited exposure that subjects had working with the collaborative system, the results are encouraging.

The interface style's lack of an effect on perceived usefulness can also be explained. Again, Gefen and Straub (2000) show that perceived usefulness is associated with the extrinsic characteristics of information technology, meaning, that perceived usefulness is "a response to user assessment of … how information technology helps users achieve task-related objectives such as efficiency and effectiveness" (p. 1). Again, the amount of system exposure and the subjects' motivation to use the system could account for the interface style's lack of effect on perceived usefulness. Subjects' motivation to use the system was voluntary and had no other associated cost such as a grade in the course.

The level of experience using different software applications had an effect contrary to what other research has described. The level of experience had no effect on the perceived ease of use of the collaborative system. Liaw (2001) showed that with more computing experience, users' computer anxiety decreased. Lee and Bobko's (1994) research indicated that in complex task situations, the complexity of requiring individuals to estimate numerous skill and motivational parameters may increase the error of assessment. The complexity level of the collaborative system could explain why the level of experience had no effect on perceived ease of use. Users of a collaborative system would not only have a higher anxiety level about the software due to the numerous components that must be mastered in order to effectively use the system, but the complexity level of the system increases with each new component the user adds to complete a given collaborative task.

The research done by B. Smith et al*.* (1999) suggests that a single quantitative measure of computer experience may not fully explain a user's perception of computer experience. Rather both a quantitative (objective) and qualitative (subjective) measure of computer experience may be required. This would also explain the lack of effect on perceived ease of use because the scale used to measure the level of experience was objective in nature.

Al-Gahtani and King (1999) reported that "the relative advantage of the system perceived by the user was the most contributing factor" (p. 290). This statement would support the conclusion that level of experience did have an effect on perceived usefulness. As the user learns about the system, they can see more advantages to using the system, therefore the 'usefulness' factor is increased. Even if the user is unfamiliar with an application, if its purpose and capabilities are explained to the user, then their level of experience can help them assess whether the application is useful to them. The idea of familiarity with multiple applications increases perceived usefulness is also supported by Liaw (2001).

Future Considerations

Additional study of synchronous collaborative environments with a diverse set of components is necessary to increase the knowledge and the development of support for using TAM as a tool for user interface evaluation. If possible, future researchers should attempt to collect both self-report and objective usage data for analysis. This would help in resolving questions regarding this construct and its effect on previous TAM research.

Although this study seems to suggest that TAM can be used as an evaluation tool for user interface acceptance and the corresponding system acceptance, other factors appear to be associated with the complex issue of user interface usability. These factors should be clearly identified with their relationship to TAM and added to the body of knowledge regarding user interface usability and TAM.

A final future research area for TAM would be in determining the value and status of an experience component. It could be that a purely objective measure is not the appropriate measure of experience as it relates to TAM. Since TAM's primary factors are perception based, then perhaps a subjective measure of computer experience is also required.

APPENDIX A

TRAINING MATERIALS

Fund for the Improvement of Post-Secondary Education (FIPSE)
Virtual Collaboration University (VCU)

Consent to Participate

Thank you for agreeing to participate in this study to assess learning outcomes, collaborative work, and information seeking in the Virtual Collaborative University. You will not receive any direct benefit from taking part in the study, but the study may help to increase knowledge that may help others in the future.

You will be asked to use your student ID number on several surveys for this project. However, all analyses for this project will be done without reference to you or any other individual. The information you provide will be kept confidential.

By using the Virtual Collaborative University and completing the surveys you are implying that you have consented to participate in this study.

Dr. Kathleen Swigger (940/565-2817) and Dr. Robert Brazile (940/565-4176) are the co-investigators for this study. Please contact either of them if you have any questions about the study or what you are expected to do.

You do not have to participate in this study if you chose not to do so, it will not affect your course grade or relationship with the University of North Texas.

This project has been reviewed and approved by the University of North Texas Institutional Review Board for the Protection of Human Subjects in Research (940/565-3940).

Getting Started with the V.C.U. System

To begin using the V.C.U. activities and working with your group, you need to activate the V.C.U. System on your workstation.

1. The V.C.U. software will be located in different folders on the Start Menu, depending on decisions made by the network personnel responsible for each computer lab. If you need additional help finding the menu option for the V.C.U. software and you are using a computer lab at the University of North Texas ask one of the lab personnel to help you find the software on the menu.

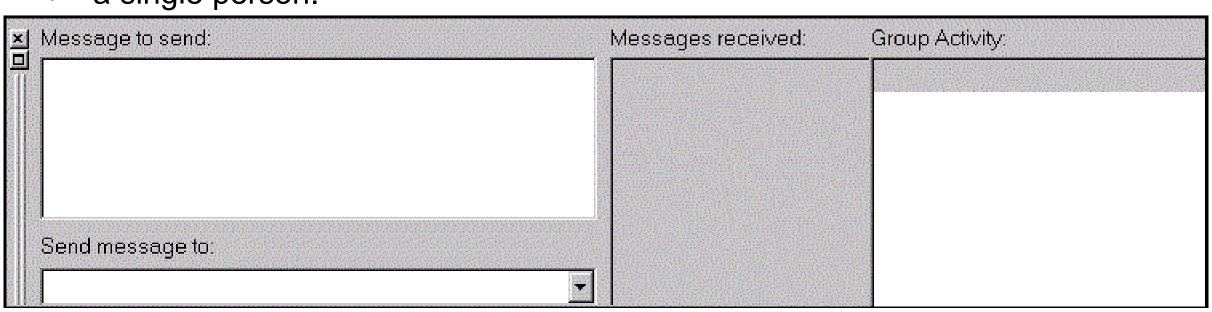
2. After you select the V.C.U. option from the Start Menu, the V.C.U. System will display the main window on your workstation.
   - At this point, the V.C.U. activities are not yet available.
   - If you sent a Chat message to "everyone in the system", only you would receive the message!

3. To begin using the V.C.U. activities, first select the Activate system option on the System Menu. You will be asked to enter your User ID Number. Enter the numbers of your User ID without any dashes.
   - Now Chat and Post a note are available.

V.C.U. Chat

Chat is like a telephone call. Using Chat, you may communicate with others who are active in the V.C.U. System. You can send messages to:

- everyone active in the system;
- everyone in your class;
- everyone in your section;
- everyone in your group; or
- a single person.



To send a message:

- Select the person or group to receive your message, using the arrow button by the text box titled "Send message to".
- Type your message in the white text area titled "Message to send".
- Press the Enter Key.

The Chat Window displays messages that you receive from individuals and from a group. The messages will be displayed in the area called "Messages Received".

The area for entering Chat messages and viewing Chat messages is always available unless you close it using the Close Button. To restore the Chat Window once it has been closed:

- Select View on the V.C.U. Main Menu.
- Now, select the "Chat Window" option to display the Chat Window once again.

Saving Images from the Internet
For Use in the VCU Whiteboard

Find an Image on the Internet

Once you have located an image (no larger 512K) you would like to use, follow these steps:

1. Select the image with a right mouse click.

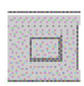
2. Choose “Save Picture As” and follow the normal steps for saving (select where to save the file, the file name, and the file extension – this information will fill in for you automatically in most cases).

Reminder: Be sure to note the directory, file folder, file name and extension. If you renamed the image, make note of the new file name including the extension.

Placing the Image in the VCU Whiteboard

Once you have located and saved an image you would like to use, communicate within your group to have one person open the Whiteboard. Decide which group member will show their saved image first

Follow these steps to place the saved image on the VCU Whiteboard to share the image with your group:

1. Select the Rectangle Tool ()from the Whiteboard toolbar. Use this tool to make a rectangular shape on the Whiteboard to insert your image.
2. Choose Select Tool ()from the Whiteboard toolbar.
3. Left click the mouse on the rectangle you just drew to select that shape to work with.
4. Now, right click on the rectangle to show the "properties" menu for this shape. On this menu, select "Properties…" and the Shape Properties dialog will appear.
5. In the edit box labeled "Add Image to Shape", either type in the appropriate file name or select "Browse" to find the file you want to place in the Whiteboard.
6. If you want the image to display just like you saved it, select "Change Size of Shape to Fit Image."
7. If you would like to make other changes, just repeat steps 2-4 to change the text on the shape, change the border's width, or change the fill option.

Note: Remember in the whiteboard the “Delete” command will erase the last action taken – regardless of who in the group did that action in the whiteboard.

Quick Steps for VCU File Sharing

Start the VCU software; it will be located on a submenu from the START/Program Menu or as an item directly on the START/Program Menu.

From the System Menu, select “Activate the System” and Enter your VCU ID in the dialog box.

From the System Menu, select “Connect to group” and make sure your current course, section and group are selected. Then press Ok. If you need to change to a different course, section and group, you can do that here.

Use the VCU Chat tool to communicate with group members. Select “Everyone in my Group” from the drop down list.

HINT: Communicate, communicate, communicate! Use the Chat to discuss the next action and to tell your team every time you are about to do something. The first step in a successful session is to decide who will be the Exchange Leader (EL) for this session.

The Exchange Leader should use View Menu “Who’s Connected…“ to verify that the other team members are connected to the appropriate group.

When the group is ready to Share a File (so the assignment can be completed), the Exchange Leader will:

NOTE: Only the Exchange Leader needs to do step 1.

1. From the VCU Actions Menu, select "Start Exchange", and then "Lead Exchange". Once in the "exchange mode", all team members can Share a File.
2. Use Chat to tell your team that you are ready to send a file and that they (The Receiver) need to decide where they want to receive the file being sent to them from you (The Sender).
3. The Receiver should select from the VCU Actions Menu, "File Transfer", and then "Options". Enter the folder name to receive the file being sent to you (The Receiver), or use "Browse" option to select a folder.
4. The Receiver will notify The Sender through Chat when they have completed this step.
5. The Sender then selects from the VCU Actions Menu, "File Transfer", and then "Send a file". Use the "Open" dialog to select the file to send. Once the Sender selects the "Open" button, the file is sent.

Quick Steps for VCU Application Sharing

Start the VCU software; it will be located on a submenu from the START/Program Menu or as an item directly on the START/Program Menu.

From the System Menu, select "Activate the System" and Enter your VCU ID in the dialog box.

From the System Menu, select "Connect to group" and make sure your current course, section and group are selected. Then press Ok. If you need to change to a different course, section and group, you can do that here.

Use the VCU Chat tool to communicate with group members. Select "Everyone in my Group" from the drop down list.

<u>HINT:</u> Communicate, communicate, communicate! Use the Chat to discuss the next action and to tell your team every time you are about to do something. The first step in a successful session is to decide who will be the Exchange Leader (EL) for this session.

The Exchange Leader should use View Menu "Who's Connected…" to verify that the other team members are connected to the appropriate group.

When the group is ready to Share an Application (so the assignment can be completed)

From the Programs Menu, select an application to be shared (i.e. MS-Notepad, or MS-WordPad). This application should be minimized, so that it will not interfere with the next few steps. It does not matter which workstation the application being shared is located on.

<u>NOTE:</u> Only the Exchange Leader needs to do step 2.

If you are already in "exchange mode" from doing File Sharing, then you do not need to do this step. From the VCU Actions Menu, select "Start Exchange", and then "Lead Exchange". Once in the "exchange mode", all team members can Share an Application.

From the Actions Menu, select "Show an Application" -- a dialog box listing Applications that can be shared will appear.

Select (highlight) an application to share, Click SHARE, then click CLOSE. (If an incorrect application is selected, reopen the dialog box, highlight the incorrect one and select Don't Share, then repeat the step above to share the correct application).

The application to be shared is in the Taskbar; it needs to be "brought forward" by each group member to view at his or her computer.

<u>NOTE:</u> This is an application outside of the VCU system, so the normal MS-Windows conventions are in place. For example, if the EL uses the VCU Chat tool to

communicate with group, the Shared application will be hidden on the EL's screen and will go to hatch marked on the group members' screens. The EL needs to click on the application in the Taskbar to bring it forward (make it the active window).

If the EL selects "Work Together" from the Action Menu, this allows others in the group to "take control" of the Shared Application. A single left mouse click allows any member of the group to "take control." This a powerful option, remember the "rules of communication" and the group work discussion.

When the assignment is complete, the file can be saved or printed only from the workstation that is actually running the application.

Tips for Teaming
Working Together to Achieve

Elements of Cooperative Learning and Work

Positive Interdependence

Team members must feel that they need each other in order to complete the group's task, that they "sink of swim" together. Positive interdependence is the perception that no member of the team can succeed unless the others do, and one member's work benefits another and vice versa.

Individual Accountability

Team learning is not successful unless every member has learned the material or has helped with and understood the assignment. Thus, it is important to frequently stress and assess individual learning so that group members can appropriately support and help each other.

Interpersonal and Small Group Skills

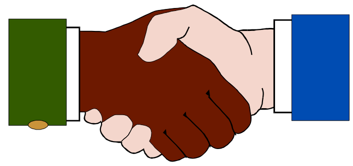
Individuals often do not come to school or work with the social skills they need to collaborate effectively with others. Time needs to be given to learning the appropriate communication, leadership, trust, decision making, and conflict management skills in order for groups to function effectively.

Group Processing

Processing means giving the team the time and procedures to analyze how well their groups are functioning and how well they are using the necessary social skills.

Taken from: The New Circles of Learning: Cooperation in the Classroom. D.W. Johnson, R.T. Johnson, and E.J. Holubec. Alexandria, VA: Association for Supervision and Curriculum Development, 1994.

Elements to Practice for Successful Cooperative Learning and Work



Specify Desired Cooperative Behaviors

- Encourage each other to participate.
- Have each member explain to their group how to get the answer.
- Check to make sure everyone in the group understands the material.
- Criticize ideas, not people.

Practice The Behaviors The Team Decides It Values

Have all team members present.

Spend time developing the ground rules for working together.

Enforce the ground rules (each member is responsible for this).

Encourage and make it possible for team members to raise difficult, subtle, and conflictual issues relating to the team's work and performance.

Taken from: The Fifth Discipline: The Art and Practice of the Learning Organization. Peter M. Senge. New York: Doubleday, 1990.

APPENDIX B

TASKS

Math 5350 V.C.U. Assignment – Group Problem Solving

The STEPS problem

A man and a woman are standing side by side with their weight on their right feet. They begin by walking so that each steps out on his or her left foot. The woman takes three steps for each two steps of the man. How many steps does the man take before their right feet simultaneously reach the ground?

The STICKS problem

Twelve sticks are arranged so that they form three squares. Rearrange the sticks to make eight squares.

Sticks diagram

The WHO DID IT? problem

In this problem only one statement is true. Determine from the information given who did it?

- A said, "B did it."
- B said, "D did it."
- C said, "I did not do it."
- D said, "B lied when he said I did it."

GEOG 4240 TEAM EXERCISE

This exercise requires a team effort using the Virtual Collaborative University concept and software. The idea is to allow all team members to work on the same computer screen at the same time even when the members themselves are at different locations.

The exercise itself involves identifying features in the general circulation from images found on the internet. The idea is to find good examples of all of the pressure cells in the general circulation in as few images as possible. How it is more important to have good examples properly identified than just a few images. There are several ways to divide the workload among the members of the team. For instance, each member might take one cell in the 4-cell model and try to get as many examples as possible. Then the entire team can review persons work and collectively select and label the best examples. Alternatively, each person might get as many good images as possible and then the team selects the best for final submission. You must use the internet, but choice of sites and images is yours.

Note some sites are going to be much better than others and much better for certain types of weather information. For examples of hurricanes, Florida State University, the University of Miami, or the National Hurricane Center would be the best choices. However there is a well known professor (Prof. Gray) at Colorado State University at Ft. Collins, CO who issues predictions of how many hurricanes will form each year, so this site would probably be a good choice also.

Note also that most sites have only current weather info. If they do archive old stuff, it is generally not available. This can create problems getting examples of certain features. For instance, Sub-polar low pressure cells (SPLOs) are almost non-existent during summer in the Northern Hemisphere, so a July image is probably not real helpful. Low pressure cells, of any kind, are identifiable by cloud patterns, but high pressure cells are usually identifiable by a lack of clouds.

The second stage is to get the northern hemisphere 500mb chart (map not image) and then to link the features identified on the images to features on the chart.

Remember that these graphic images are large files and transfer rates will probably be slower than you would like. It would probably also help to work at a time of day when the internet has relatively little use instead of in the evening when it has maximum use. In any case "Patience is a virtue".

Finally each team will have a specific time to consult with your instructor (me), answer questions etc. Again this will be done using the same software.

Just to refresh your memory, there is a detailed write up on the general circulation in your packet. Find and identify the following features in each hemisphere.

- Sub-tropical High (STHI) Polar high
- ITCZ (Inter-tropical Convergence Zone) Trade winds? Siberian high Anarctic high
- Canadian High Sub-polar low (SPLO)
- South Asian Low Indonesian low
- Hurricanes/ Tropical Storms Westerlies
- Orographic precipitation Cyclones (Mid-latitude Cyclonic Storms)
- Rain Shadow Deserts Anticyclones
- Dry Line

SLIS 5660 Government Information

EXERCISE ON EVALUATING FEDERAL STATISTICAL WEB SITES

General Instructions:

1. You are assigned to one of 3 groups.

2. Each group is assigned a specific federal statistical website to evaluate. The groups will use the V.C.U. software for this exercise. The V.C.U. software applications used for this exercise include: Browser, Group Chat, File Sharing, and Application sharing.

3. The websites have been saved to the Network Server using WebWhacker software. You will not be connecting directly to the Internet.

4. Each group will designate one person to serve as the Group Scribe. The Group Scribe will enter the website evaluation comments made by Group Members into the Group's Evaluation Report File. At the end of the session each group member will save a copy of the Group Evaluation Report File onto a personal diskette.

5. At the next class session each Group will present its Evaluation Report to the Class and demonstrate the site's features as well as the methods used to answer the specific statistical reference question for that site.

6. Each person will share his/her search strategies used to answer the specific statistical reference question for that site.

GROUP EVALUATION REPORT

Instructions: Use the Outline below to organize your evaluation. Refer to your copy of Table 2 "Criteria for the Evaluation of Websites," pages 184-185 of Government Information Quarterly, vol.14, no.2, 1997, for suggested evaluation features under each criteria.

CRITERIA FOR EVALUATION OF FEDERAL STATISTICAL WEB SITES

I. INFORMATION CONTENT CRITERIA

a. Orientation to website
b. Content
c. Currency
d. Bibliographic Control
e. Services (if provided)
f. Accuracy
g. Privacy

II. EASE-OF-USE CRITERIA

a. Quality of Links
b. Feedback Mechanisms
c. Design
d. Navigability

III. ANSWERING A STATISTICAL REFERENCE QUESTION USING YOUR ASSIGNED SITE: (Your group will be given your question in class)

a. Does the site offer a "Search this Site" feature? Yes or No

b. If YES, what search strategy did you use to find the file answering the statistical question?

   Give the URL for the specific file where the answer is found.

   URL: file://

c. Use the menu options from the site's Home Page to find the answer to the statistical question.

   What search strategy did you use?

   Give the URL for the specific file where the answer is found.

   URL: file://

COMM 2020: INTERPERSONAL COMMUNICATION

GROUP PROBLEM-SOLVING AND REPORTS

Overview: Your group will select a case to study, analyze, and develop solutions. You will work as a group in problem-solving and creating a written OUTLINE of the group's proceedings. As a result of your group's analysis and solutions, individuals will make PRESENTATIONS in your groups on the problems and solutions. As future (and current) members of organizations, each of you will be asked to communicate interpersonally in ways that assist in the analysis of problems that lead to decisions. This assignment can be of real value to you if taken seriously. It is intended to help prepare you for very "real world" types of tasks.

1. Form a group with compatible classmates with diverse abilities. Because you will need to work together outside of class, it is important that you have compatible schedules. Exchange phone numbers and schedules.

2. Select one of the cases. Have a first, second, and third choice so that different cases can be used in class.

3. Review AGENDAS, CHAPTERS 12 & 13, CLASS NOTES AND HANDOUTS ON DECISION-MAKING.

4. DO GROUP DISCUSSION PHASE

Spend considerable time discussing and analyzing the case, then arriving as solutions. All should try to contribute to the discussion. Be aware of the agendas presented, and develop or make combinations of those agendas to suit your case and your group=s needs. You will need, most likely, to make modifications in your agenda as your group proceeds through its tasks.

a. Each stage the group goes through should be recorded.

b. Only KEY issues, definitions, information, analyses, criteria, etc. that arise at each stage should be recorded.

c. Solutions in comparison to solution criteria and key issues should be recorded.

d. Viable solutions or combinations of solutions should ultimately be determined by your group.

5. DO WRITTEN OUTLINE

The group should decide on how to produce the written OUTLINE (e.g.,responsibilities, deadlines, etc.). The written outline can be created as the group proceeds through discussion and revised/edited if necessary after. THE OUTLINE SHOULD

a. Cover each stage of the group's agenda and use a heading for each stage which names the stage.

b. Report on the process the group went through at each stage. c. Report only the key information, the key analyses, and solution decisions at each appropriate stage.

(SEE a - d under "4" above).You cannot and should not report everything in the outline.

GROUP REPORTS

As a group, you will make individual presentations based upon your case and your group discussions. Much of the quality of the presentation will be determined by what you did in your group discussion. Your presentations should not follow the agenda or outline used to arrive at solutions. Rather, you should divide up responsibilities for focusing on various problems, analyses, explanations, and solutions. Every presenter should use at least one visual aid.

Each presentation will require class volunteers to serve in roles that the group reports to. These volunteers will play their role in their panel and ask questions of the presenters.

As future members of organizations, each of you, often as part of a team, will be asked to solve problems and give presentations for your superiors. This assignment is designed to help prepare you for these types of presentations.

Organize, Plan, Prepare, Rehearse, Present

1. ORGANIZE and sign up on the schedule.

2. PLAN a format for the presentation. See "FORMAT FOR FORMAL GROUP PRESENTATIONS."

3. PLAN BY carefully dividing up parts of the presentation. Each member should speak for approximately equal times.

4. PREPARE BY using your case and outline for information.

5. Carefully PREPARE the oral presentations and visual aids.

6. REHEARSE as a group and individually.

7. PRESENT the report in class. Limit the group presentation to 30 minutes. We must have 2 groups w/questions per class meeting. Because this is a formal presentation, each group member must dress for the occasion.

APPENDIX C

QUESTIONNAIRE

Comparative Analysis Questionnaire

1. What type of operating systems have you worked on (choose all that apply)?
   ___Microsoft Windows ___Macintosh ___UNIX
   ___DOS ___LINUX ___Other
   If you checked "Other" in the above question, please explain: ________________

2. For each type of application that you use, use the following descriptions to indicate your level of experience.
   Level 1 = learning to use the operating system (e.g. Microsoft Windows or Macintosh) and getting comfortable with the idea of creating text, moving around in it, and revising it.
   Level 2 = use your operating system easily, gotten familiar with several different features/programs, and feel comfortable with the idea of exploring and learning new features/programs.
   Level 3 = have an active interest in how the program works, feel at ease with customization, writing macros.
   Level 4 = thoroughly familiar with the programs, simultaneously run multiple applications, integrate applications.

Applications:	Never Used	Level 1	Level 2	Level 3	Level 4
Word Processing					
Spreadsheets					
Databases					
Presentation					
E-mail					
Web Browsing					
FTP					

3. What is your age (choose a range)?
   ___Less than 20 ___20-29 ___30-39 ___40-49 ___50-59 ___60 or more

4. What is your gender? Female____ Male____

5. Which of the following best describes your ethnic background (choose one)?

   ___American Indian or Alaskan Native ___Hispanic
   ___African American, Black ___White, non-Hispanic origin
   ___Asian, or Pacific Islander ___Other

6. What Year are you in school? (Check only one)

___Freshman
___ Sophomore
___ Junior
___ Senior
___ Post Baccalaureate
___ Masters Student
___ Doctoral Student
___ Post Graduate
___ Not enrolled
___ Other: _______________

Experience with Collaborative Software

Please indicate the extent to which you agree or disagree with each of the statements below by choosing the response that corresponds to your feelings, opinion, or experience.

1=Strongly Disagree 2=Moderately Disagree 3=Slightly Disagree
4=Slightly Agree 5=Moderately Agree 6=Strongly Agree

	1	2	3	4	5	6
Technology enhanced my ability to learn the material.						
I found the use of multiple tools to be overwhelming.						
The use of the collaborative software was valuable to my learning in this class/completion of this project.						
I spent too much time trying to learn to use the collaborative software.						
I could use technology that I learned for this project outside the context of this class.						
I was at a disadvantage in this project because I do not possess adequate computer skills.						
Because of the collaborative software I was better able to visualize the ideas and concepts that were taught in the course.						
Chat helped me communicate with other students in the class about the project.						
Because of the collaborative software, I enjoyed this course more than I would have otherwise.						
The availability of the collaborative software in another class requiring group work would be an attraction to me.						
The availability of the collaborative software in another class would deter me from taking the class						

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