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It's Not Just About the Technology: Changing the Focus from Technology to Collaboration in Videoconferencing Room Design

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IT'S NOT JUST ABOUT THE TECHNOLOGY: 
CHANGING THE FOCUS FROM TECHNOLOGY TO COLLABORATION 
IN VIDEOCONFERENCE ROOM DESIGN

A Dissertation Presented to 
The Faculty of the Educational Leadership Doctoral Program 
Western Kentucky University 
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In Partial Fulfillment 
Of the Requirements for the Degree 
Doctor of Education

By 
Tamela W. Smith

May 2013
IT'S NOT JUST ABOUT THE TECHNOLOGY:
CHANGING THE FOCUS FROM TECHNOLOGY TO COLLABORATION
IN VIDEOCONFERENCING ROOM DESIGN

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Videoconferencing technologies are being increasingly utilized in today’s business and educational environments. However, implementation rates continue to be lower than projected, and user perceptions on the level of collaborative environment provided by videoconferencing rooms vary widely, depending on room design. This study found that, while few videoconferencing professional characteristics impact the level of collaborative environment designed for end-users, the perceived closeness levels provided to end-users significantly impacted their perceptions on the technology. The study also found that videoconferencing professionals’ views and end-users’ views on the level of collaboration within videoconferencing environments vary significantly. By shifting the design of videoconferencing rooms from a technology-centric view to a more collaborative-centric view, end-user satisfaction improves. For business and educational applications, improved levels of collaboration will result in more productive and meaningful communications.
CHAPTER I: INTRODUCTION

Videoconferencing systems, which provide synchronous computer-mediated audio and video communications between participants in different geographical locations are being implemented at an increasing pace in industry and education. However, many areas regarding these technologies and their adoption have yet to be researched. A review of the existing literature focusing on the synchronous type of computer-mediated communications (CMC) found that much of this research is focused on the non-face-to-face tools such as text or chat (Pantelie & Dawson, 2001). One study published in 2006 in the *Journal of Computer-Mediated Communication* defined CMC as “any human symbolic text-based interaction conducted or facilitated through digitally-based technologies (Spitzberg, 2006). Because the focus is on the tools that do not provide the virtual face-to-face experience, the research does not cover the newer, richer media capabilities now being offered (Jiang, Bazarova, & Hancock, 2011; Walther, Van Der Heide, Tong, Carr, & Atkin, 2010).

While every article on videoconferencing technologies mentions its abilities to provide face-to-face communications, few address the technology design and installations necessary to accomplish this. Studies on the effectiveness of communications within videoconferencing environments often focus on how the technical aspects of room design impact collaboration but do not address how to resolve the issues (Carville & Mitchell, 2000; Currie, 2007; Seay, Rudolph, & Chamberlain, 2001; Silverstein & Lineberry, 2002) Most videoconferencing room implementations are guided by the information technology (IT) areas, but little empirical research is available on how often the room design is guided by end-users’ actual needs for the room or the impact of design on collaboration.
End-users have traditionally had little say in these IT implementations. Adding to the issues is the fact that many end-users feel a disconnect exists between the IT personnel’s understanding of what users actually need (Kettinger & Lee, 2002). Emphasis on the results should not be on the technology itself, but should be on how the technology facilitates the communication requirements of the end-users (Miner, 2009; Silverstein & Lineberry, 2002; Snyder, Marginson, & Lewis, 2007). One paper presented at the American Society for Engineering Education’s Annual Conference and Exposition indicated that the design of videoconferencing rooms, in this case for distance education, seemed to be driven by the technology and not the andragogy for the students (Silverstein & Lineberry, 2002). The paper further discussed how specific technologies, while fully functional from the technical side, were not meeting the needs of the faculty and students. While usage is growing, videoconferencing adoption rates and acceptance continue to be lower than predicted. A need for research exists on best-practices for designing videoconferencing systems that ensure the rooms create the optimal collaborative environments needed.

**Background**

While industry and education have for years utilized a variety of technologies to allow synchronous communication among participants at differing locations, the early technologies were challenging and expensive. Initial collaborative methods of communication began with audio-only connections, which were accomplished through telephones and speakers, then progressed to one-way video through the utilization of microwave technology. When videoconferencing capabilities were first introduced in the 1960s, these early systems were cost-prohibitive to individuals and small organizations.
By the 1980s videoconferencing had become more commercialized, allowing for the installation of real-time two-way audio and video technology to be implemented in classrooms and boardrooms. These videoconferencing sessions utilized devices called codecs to compress and decompress the transmission between the systems. These traditional room-based systems featured a configuration of cameras and microphones for end-users, allowing full, real-time audio and video interaction among all participants through H.320 standards. H.320 is defined as “narrow-band videoconferencing over circuit-switched networks” (Cisco, 2013, p. 3). With H.320 standards, systems used dedicated networks to transmit the audio and video signals, and the systems worked well. Because rooms were connected with dedicated lines, they could primarily communicate only within their own networks of rooms, limiting their ability to provide broader collaborative capabilities without incurring large costs.

In the 2000s the technological enhancements allowed videoconferencing capabilities to move to H.323 standards, which is defined as “narrow-band videoconferencing over non-guaranteed quality-of-service packet networks” (Cisco, 2013, p.3). This technology now allows for room-based systems to connect with other room-based systems connected to the Internet, effectively opening up the ability to collaborate with countless endpoints around the globe.

These room-based systems are experiencing increased usage with the ever-increasing demand for collaboration in a global environment, threats such as terrorism, and the rising costs of travel (Nunamaker, Reinig, & Briggs, 2009). Room-based systems, which can cost as high as $350,000 per room depending on the design, have seen some pricing decreases on smaller installations, which has helped to fuel the growth
in rooms (Video Conferencing History, 2011). The *Technological Horizons in Education* journal reported a growth of more than 20% in enterprise videoconferencing adoption in 2011 (Meyer, 2012). The quality of the technology continued to improve with the implementation of high-definition codecs to drive the meetings and high-definition monitors for improved video viewing. Videoconferencing rooms today can be designed to provide the highest standard of audio and video technologies, document sharing, and multimedia tools to promote a high level of collaboration among participants. The high-end telepresence rooms are designed to provide life-size images of remote participants and are promoted as able to provide an environment where it actually feels like the participants were in the same room. With the significant changes in how videoconferencing technologies are transmitted, studies conducted in this area before the mid-2000s may need to be examined more closely to determine if findings related to transmission and connectivity remain relevant today.

While the accepted standard in videoconferencing connectivity is H.323, no accepted standard definition of a videoconferencing room can be found. The type of equipment, room design, and functionality of technical installations within the rooms vary from site to site. Beyond the basic required equipment, room designs can vary widely from very basic installations to the most advanced telepresence rooms (Coventry, 1994). Even the newer terminology of telepresence has no standard definition other than it is most commonly considered to provide images of the distant participants that are equal or nearly equal to life-size with the gaze angle reduced to a minimum (Wainhouse Research, 2010). Telepresence may or may not include a variety of other multimedia tools with varying collaboration capabilities. Some videoconferencing rooms contain a
large array of the latest technical innovations, while others contain only the minimum required technologies for making the connections. In research, the word “collaboration” is often used, but it is typically not defined or the definitions are inconsistent (Kennedy & Stewart, 2011). With limited definitions on the term, for the purpose of this study the term “collaboration” will be defined as the synchronous interaction between and among participants through verbal and non-verbal communications in a virtual meeting environment.

These differences are critical, as certain types of technology installations allow for enhanced participant interaction and facilitate greater collaboration and communication, while others do not provide this type of environment. Issues that may hinder communication in one room may not exist in another room with a different installation design. However, since both are called videoconferencing rooms, any differences are obscured. Some organizations provide for technical features that make human interaction with the technology nominal, while other endpoints require training and conscious thought on usage on the part of the participants. When examining these crucial differences between endpoints, it becomes apparent why studies of videoconferencing that do not clearly define the term and address endpoint design variances are missing a key variable in their analysis. Without this key variable, obtaining a clear understanding of what leads to a successful videoconferencing session is difficult. Because the level of participant communication ultimately determines the success or failure of a videoconference, it is imperative not to overlook the variable of technical functionality that promotes or inhibits this participant communication, not simply whether audio and video was provided (Carville & Mitchell, 2000; Currie, 2007; Seay et al., 2001;
Silverstein & Lineberry, 2002). A study conducted by Wainhouse Research in 2010 indicated that only half of the interviewees measured the success rate of the videoconferencing sessions they provided, in part because it is complicated to measure as no standard definition exists for success or failure within videoconferencing.

**Rationale For Study**

Current research into computer-mediated communications has focused primarily on the asynchronous capabilities of the technology such as email or chat. Asynchronous collaboration tools have become soundly instilled in the workplace and education. With asynchronous communications, individuals do not communicate simultaneously but can post and respond at their own convenience through tools such as chat, text messaging, discussion boards, or email. Numerous empirical studies have been conducted in education on the use of asynchronous computer-mediated communications, or online courses, for distance learning. A recent search of EBSCO found more than 5,000 articles related to online education, more than 3,000 were retrieved for online courses, and a search for online learning found more than 7,000. Online courses have added value to postsecondary educational institutions by allowing students to participate anytime from any location (Palmer & Holt, 2010), thereby increasing access to courses and content. As the number of non-traditional students has risen this format has worked well for both students and faculty (Day, Lovato, Tull, & Ross-Gordon, 2011; Schuetze & Slowey, 2002; Tonn & Meeks, 1984). Research also has been conducted on how these applications are utilized in the workforce (Joo, Lim, & Kim, 2012).

For all of the benefits, some of the same components that make asynchronous communications so valued also create issues. Participants do not receive immediate
feedback to ideas, thoughts, or suggestions and have to wait until others respond. Participants do not become as connected with the others involved, since they do not see them and aren't provided with the chance to engage in more social interactions required to connect with others (Branon & Essex, 2001; Huang & Hsiao, 2012). Synchronous computer-mediated communications, which can include technologies such as videoconferencing, can provide environments where participants can build closer connections and stronger ties (Pickering & King, 1995).

While some studies have been conducted to determine end-user satisfaction with videoconferencing technology, few have accounted for the effect of differing room functionality and design on participant communication and satisfaction with the collaborative experience. While the preponderance of research correlates user attitudes with the videoconferencing room characteristics, little is available on how to best implement the technology aspects into room design to promote improved user satisfaction. Studies into videoconferencing emphasize the positive aspects of the participant’s ability to see faces, recognize nonverbal communication cues, and build a sense of social connection with those in distant locations (Grady, 2011; Meena, Singh, Meena, & Kanwat, 2012; Panteli & Dawson, 2001; Yamada & Akahori, 2007), but the research does not discuss how the room design facilitates or hinders this communication (Schullo, 2005). The type of equipment, room design style, and functionality of technical installations within rooms vary from site to site.

Prior studies have used the terms “videoconferencing” or “interactive television” ubiquitously, which is misleading. With the variety of factors that influence the collaborative capabilities within a videoconferencing facility, the differences in room
design have a direct impact on the success or failure of these sessions. Without accounting for the variations in design and functionality, studies of satisfaction cannot be generalizable. While the preponderance of research correlates user attitudes with videoconferencing room characteristics, little empirical research can be found on how best to implement the technology aspects into room design that will promote improved user satisfaction.

User satisfaction is related to the level of collaboration provided by the videoconferencing room characteristics. It is the collaborative environment provided by these unique settings that makes videoconferencing rooms valuable in business and education. Being able to collaborate among participants in geographically differing locations provides the value in videoconferencing systems.

Room characteristics that affect user satisfaction typically start with the participants’ ability to see other participants. Decisions on technical aspects range from whether the viewing screen is the right size, whether it is in the right location, and how participant faces are displayed on the screen. How the technology is implemented impacts the participants’ abilities to recognize nonverbal cues from others. Decisions on microphone placement impacts whether participants can be heard properly by the other sites, and how much interaction must occur with the technology. Do participants have to activate a microphone to speak, or is the room designed where audio is automatically broadcast without human interaction? Are cameras positioned to limit gaze angle and promote eye contact between participants? These aspects and how they are incorporated into room designs can promote or inhibit the communication capabilities possible within rooms (Wegge, 2006).
Audio and video designs can influence how participants see others in a meeting. Low audio may cause the speaker to be perceived as less confident, and monitor angle can affect the influence participants have in the group dynamics. One study found that “Physical placement of video cameras, zoom angles and monitor distance can distort people's perceptions of closeness and height” (Huang, Olson, & Olson, 2002, p. 2). This is important because, as shown in the same study, participants’ perceptions of closeness and height influenced how they interacted with each other, including level of influence on group decisions. Studies on gaze angle indicate how important this room characteristic is on the success or failure of a meeting (Badler, Badler, & Lee, 2002; Gemmell, Toyama, Zitnick, Kang, & Seitz, 2000; Huang et al., 2002; Macrae, Hood, Milne, Rowe, & Mason, 2002). However, the authors of one study indicated they had not found technical implementers as perceptive on how influential this room characteristic is on group dynamics (Huang et al., 2002). In conjunction with gaze angle is the importance of seeing eye movements, which play a valuable role in social awareness and interactions (Badler et al., 2002; Macrae et al., 2002).

**Statement of Problem**

Organizations that chose to adopt videoconferencing to provide synchronous computer-mediated communications experience many benefits. However, while the technology is being implemented, participant satisfaction with it is often lacking (Coventry, 1994). Lack of end-user satisfaction may be a factor in the adoption rate. Although the videoconferencing industry has experienced much growth in the past few years and continued growth is predicted for the future, a need exists for research into best-practices on design and implementation of videoconferencing systems to ensure the
rooms create the required optimal collaborative environments. By shifting the emphasis on room design from the technology to the participants, videoconferencing might change from being something that organizations have to use to save time and money, to becoming something they find beneficial and want to use.

**Research Questions**

Videoconferencing sessions consist of two distinct but equally important aspects. First, the technical side allows for the capability of the collaboration to occur. Equally important is the actual communication and collaboration that occur within a videoconference. This collaborative environment component is critical to the success of synchronous computer-mediated communication sessions, but the lack of current empirical data shows little research on how best to develop these optimal room environments (Schullo, 2005). The two distinct facets of videoconferencing success are often viewed as the “service” side and the “meeting” side (Wainhouse, 2010, n.p.). Meetings can succeed or fail, even if the technology or service side is a complete success. However, if aspects of the technology or service side fail, the meeting will fail as well. A study of information technology implementers was conducted to examine the involvement of videoconferencing room design relative to collaborative aspects for communication.

The following research questions guided this study:

Research Question 1: How do the characteristics of videoconferencing professionals relate to the overall quality of collaboration sessions, controlling for background demographic variables?
Research Question 1A: Does the level of staffing of videoconferencing professional units affect the level of collaborative capabilities incorporated into room design?

Research Question 1B: Does the level of knowledge, provided through learning opportunities and experience, affect the level of collaborative capabilities incorporated into room design?

Research Question 1C: To what extent are the characteristics of videoconferencing professionals related to the level of collaborative capabilities incorporated into room design?

Research Question 2: Does improved feeling of closeness increase participants’ perceptions on the quality of collaboration?

Research Question 2A: Does the view of remote participants increase participants’ feelings of collaboration?

Research Question 2B: Does the audio system affect participants’ feelings of collaboration?

Research Question 2C: Does gaze angle in videoconferencing rooms impact participants’ feelings of collaboration?

Research Question 3: Are there differences in the perceptions between the videoconferencing professional and end-users on how often important collaborative room characteristics are incorporated into the videoconferencing room designs?

As with any technology design, proper focus and attention should be given to all aspects of the implementation, although one study indicated that nearly two-thirds of higher education institutions neglected to properly plan for technology implementations.
Understanding how collaborative communications are facilitated through the physical videoconferencing technologies is a critical component to the successful implementation of these rooms.

**Acronyms and Definitions**

Advances in technologies occur at a fast pace, and different fields often refer to the same underlying technology with differing terminologies. Overlap also is found among the terminology, so the terms have to be viewed in their specific context to correctly understand to what they are referring. For example, E-Learning may refer to synchronous or asynchronous virtual classrooms.

*Computer-mediated communications:* This term encompasses both asynchronous and synchronous communications. Computer-mediated communications may be called CMC, online communications, Internet-based communications, virtual communications, video telecommunications, video communications, social networking, or social computing. A 2010 article for Communication in the ACM defined social computing as “intra-group social and business actions practiced through group consensus, group cooperation, and group authority, where such actions are made possible through the mediation of information technologies, and where group interaction causes members to conform and influences others to join the group” (Vannoy & Palvia, 2010, p. 149).

Webopedia, an online dictionary dedicated to Internet and computer technology, defines CMC as “human communication via computers and includes many different forms of synchronous, asynchronous, or real-time interaction that humans have with each other using computers as tools to exchange text, images, audio and video. CMC includes e-mail, network communication, instant messaging, text messaging, hypertext, distance
learning, Internet forums, USENET newsgroups, bulletin boards, online shopping, distribution lists and videoconferencing” (Webopedia, 2012, n.p.).

Asynchronous computer-mediated communications (A-CMC): A-CMC is accomplished by a variety of Internet technology tools including instant messaging, email, text messaging, and bulletin boards. Online asynchronous tools include any technical capabilities where interaction between the participants does not occur in real-time. From the technology view, asynchronous is defined by Merriam-Webster's online dictionary as “used in, or being digital communication (as between computers) in which there is no timing requirement for transmission and in which the start of each character is individually signaled by the transmitting device” (Merriam-Webster’s Online Dictionary, 2012, n.p.).

Synchronous computer-mediated communications (S-CMC): This term refers to Internet technology tools such as live chat or videoconferencing in which the technical capabilities for interaction between the participants occur in real-time. The technology view of synchronous is defined by Merriam-Webster's online dictionary as “of, used in, or being digital communication (as between computers) in which a common timing signal is established that dictates when individual bits can be transmitted and which allows for very high rates of data transfer ” (Merriam-Webster, 2012, n.p.).

Videoconferencing: Videoconferencing traditionally references a room-based system consisting of an array of camera(s) and microphone(s) to provide real-time interaction between participants who are located at geographically distant locations. This also may be known as interactive television (ITV), video teleconferencing (VTC), computer-aided synchronous learning systems, or e-Learning systems. While the term telepresence was
initially used to define the most high-end and expensive room-based videoconferencing systems, utilizing rooms with multiple codecs and multiple screens designed to mimic being in the same room with distant participants, that term now has come to be used to mean videoconferencing overall. With real-time audio and video capabilities provided by videoconferencing, virtual interactions may closely mimic face-to-face interactions.

**Desktop-based videoconferencing:** This term refers to an array of software solutions that also provide real-time audio and video capabilities connecting geographically distant participants but reside on the desktop or laptop computer. Desktop-based videoconferencing requires only software and a computer with attached web-camera, microphone, and speakers that, together, provide synchronous, virtual interaction between participants. Desktop-based videoconferencing also is referred to desktop conferencing or virtual meeting rooms. In educational settings it also may be called broadband learning, virtual classrooms, Web 2.0 synchronous learning environment, collaborative web spaces, or web-based teaching.

**Mobile videoconferencing:** This form of conferencing could be considered the next-generation of collaborative communication tools for education and industry. Enhanced technical capabilities now allow for real-time audio and videoconferencing on an array of mobile devices, such as smartphones or tablet devices, and continue to redefine conferencing capabilities.

**Transactional Distance Theory:** This theory was developed by Michael G. Moore in 1997 and states that “distance is a pedagogical phenomenon and is not simply a matter of geographic distance” (Moore & Kearlsey, 2005, p. 223). For this purpose, distance refers to the strength or weakness of the understanding between the faculty member and the
students (Giossos, Koutsouba, Lionarakis, & Skavantzos, 2009). Moore and Kearlsey theorized that the structure and dialogue are two important factors in bridging this pedagogical distance.

*Diffusion of Innovations Theory:* Diffusion of Innovations Theory discusses the starting point for innovations and how they are implemented in organizations. Initially, innovations were thought to originate from a central location and then spread through the organization. Over the years the theory changed, in that diffusion of innovations is at a more decentralized level and then introduced among organizations. In actuality, this theory exists as a hybrid of the two views (Rogers, 2003).

*Technology Adoption Model:* This model looks at the perceptions of end-users regarding the ease of use of a new technology and their perceptions on how valuable it will be in the workplace (Legris, Ingham, & Collerette, 2003).

*Collaboration:* Collaboration, as defined by Merriam-Webster’s online dictionary, is “to work jointly with others or together especially in an intellectual endeavor” (Merriam-Webster, 2013, n.p.). Collaboration is often referred to as the interactivity between parties who are typically working toward a shared objective (Kennedy & Stewart, 2011). For the purpose of this study, collaboration is defined as the synchronous interaction between and among participants through verbal and non-verbal communications in a virtual meeting environment.

*Optimal collaborative environments:* Optimal collaborative environments are created by ensuring the camera and monitor placement are located properly, the microphones and speakers are located properly, and the technical room settings are configured to provide the best view and sound from the remote locations.
Proxemics: Proxemics is the field of study focusing on how the physical arrangement of individuals influences individual behavior (Huang et. al, n.d.).

Summary

The need for videoconferencing continues to grow, as travel costs in terms of money and time increase, and as organizations have a growing demand for more global collaborations. With end-user satisfaction levels varying, a need exists to determine what can be done to improve perceptions on collaboration that occurs within videoconferencing environments.
CHAPTER II: LITERATURE REVIEW

Computer-Mediated Communication Technology

Computer-mediated communications are becoming more prevalent in today’s educational and business environments. They may include synchronous and asynchronous systems and typically use tools such as instant messaging, email, chat features, and videoconferencing. Because the area of computer-mediated communications is still emerging, many aspects regarding theory and practice have yet to be clearly defined. Even the terminology varies to include computer-mediated communications or CMC, social networking, or social computing. A 2010 article for Communication in the ACM defined social computing as “intra-group social and business actions practiced through group consensus, group cooperation, and group authority, where such actions are made possible through the mediation of information technologies, and where group interaction causes members to conform and influences others to join the group” (Vannoy & Palvia, 2010, p. 149). As the use of computer-mediated technologies increases (Bollinger & Inan, 2012; Meyer, 2012), participants must remain cognizant of the challenges faced with the addition of technology to organizational communications and operations. Reviewing communication issues within virtual groups is critical precisely because of their growing usage (Timmerman & Scott, 2006). Much debate has occurred on whether individuals can communicate well through the technology. Improvements made in technical capabilities do not automatically translate into improvements in communication. Though more collaborative tools have been introduced, including high-definition capabilities, communication issues persist. When the social networking of human interaction is overlooked, participants fail to feel a
sense of connection with the group. Participants need to feel connected, even if they are in geographically distant locations. Several studies have been conducted that focused on the human factors of networking as applied to computer-mediated communications, demonstrating how the human factor is as important as the technical factors, and providing for a theoretical underpinning for successful networking and communications among videoconferencing participants.

As early as 1995 a study was conducted that discussed how “changing communication capability alters the efficiency and effectiveness of the processes whereby organizational coordination of production occurs” (Pickering & King, 1995, p. 483). This “exponential explosion in communication technology has resulted in greater frequency of daily interactions with colleagues, coworkers, subordinates and bosses who are dispersed in different geographic locations” (Zaccaro & Bader, 2002, p. 377).

These computer-mediated sessions need to provide an environment that creates effective communication and cohesion among participants through the establishment of a social network in this virtual environment. All the important aspects of creating a sense of social network that exist within face-to-face communications, also must be addressed in computer-mediated communications (Nunamaker et al., 2009). Participants in virtual settings can and will experience the same issues and problems as face-to-face sessions. The addition of technology adds further challenges to communication (Nunamaker et al., 2009). The networking perspective is applicable when examining how groups work in a virtual environment. This perspective is defined by the ties of “individuals to individuals, groups to groups, or individuals to groups” (Katz, 2005, p. 279). The strength of member
ties within a virtual group can lead to a more successful outcome and group members feeling more connected to the organization and its objectives (Katz et al., 2005).

Nunamaker et al. (2009) utilized case studies from hundreds of actual virtual team experiences over a 10-year period to study the group dynamics in the virtual environment. They determined several effective methods for enhancing the experience for virtual team members and increasing their effectiveness. While adding the additional element of technology can compound the typical problems or issues found in traditional group formation in face-to-face environments, virtual teams can be effective. Nunamaker et al. identified several challenges to the effectiveness of virtual teams, including communication issues, technology issues, and cultural differences, all of which can lead to problems in areas such as consensus building and developing shared work processes. To meet these challenges, team leaders need to ensure all members understand the importance of the project and create a reward system that addresses this issue. Additional research supports the importance of providing a clear definition and a compelling direction for the team (Keller, 2010). Virtual teams must find ways to strengthen ties between members, while dealing with cultural differences, whether the differences occur across a state, region, or between countries. Even simple words can be misinterpreted (Brewer & Holmes, 2009), creating challenges for group formation and understanding. It is important for all standards, definitions, and terms to be clearly stated and agreed upon at the beginning.

With synchronous communications, time differences can be an issue. Leaders must schedule meetings at times that are appropriate for all time zones, which can be difficult for global teams. The selection of the appropriate technology and having
reliable technical tools to make the experience work are vital to the success of the virtual team. By providing collaborative technologies that can be embedded into everyday work procedures, the chances for success also are increased. Employees are more willing to utilize tools they find easy and convenient and do not require much additional effort to use. Email would be an example of this type of technology for most employees, and videoconferencing should provide the same ease and simplicity for virtual teamwork. Many examples of virtual teamwork, even on a global level, are found within intuitions of higher education. Administrators, faculty, and staff frequently collaborate with colleagues across regions and states, or even around the globe. The number of these collaborative workgroups continues to increase within higher education. Therefore, it is important that university leaders recognize the challenges facing these virtual teams in the technical environment and apply the principles and procedures to promote effective and successful team outcomes (Nunamaker et al., 2009).

An article, “Social Capital and Knowledge Integration in Digitally Enabled Teams,” by Robert, Dennis, and Ahuja (2008) indicated that the stronger the social capital among the members, the greater the sharing of knowledge within the team. The greatest impact on the interaction and sharing was the strength of the social and relational capital, which can be accomplished in a virtual setting (Robert et al., 2008). With more adult learners in higher education relying on computer-mediated communications to obtain access to course content (Care, 1996), a strong social networking environment is a crucial factor in the success of distance education courses (Stefanone & Gay, 2008), with social presence “regarded as an important factor to understand psychological and
emotional relations among distant learners...” (Kim, 2011, p. 763) equally critical in distance education courses.

The importance of creating a social network with the virtual environments can be tied to Michael Moore's Theory of Transactional Distance. The theory, developed by Moore in 1997 (Falloon, 2011), builds on previous works to state that “distance is a pedagogical phenomenon and is not simply a matter of geographic distance” (Moore & Kearsley, 2005, p. 223). For this purpose, distance refers to the strength or weakness of the understanding between the faculty member and the students (Giossos et al., 2012). Moore and Kearsley based their work on John Dewey's earlier ideas of transaction (Giossos et al., 2012; Moore & Kearsley; Vanderstraeten, 2002). This distance between faculty and students affects all aspects of the educational pedagogy for distance learning courses and can be measured by the varying levels of dialogue and structure that occur in the course (Moore & Kearsley, 2005). Citing earlier works by Moore and Kearsley that discussed the transactional model of distance education, Care (1996) also reviewed how to measure this distance and focused on the importance of treating all participants equally, whether in the same setting as the professor or not.

By decreasing the level of Transactional Distance in a virtual setting, participants can increase the development of social capital within virtual settings and improve communication and levels of learning. While the Theory of Transactional Distance was originally developed and applied to the educational setting, it also can and should be applied to the organizational setting. Structure can be accomplished through ensuring that standards, phrases, and goals are clearly stated and agreed upon from the beginning. Effective dialogue can be accomplished through well-planned moderation of
communication between individuals at the differing sites. Those who participate in computer-mediated communications to conduct business also will need to feel connected for the communications to be considered more successful. By increasing the structure of meetings with clear agendas and ensuring all participants are providing opportunities for dialogue, as illustrated in Figure 1, the perceptions of transactional distance can be reduced.

![Transactional Distance Videoconferencing Model](image)

**Transactional Distance - Narrowed**

More Structure
- a. Agreed Upon Goals
- b. Agreed Upon Agenda
- c. Clarity of Terminologies

More Dialogue
- a. Identified Moderator
- b. Opportunities for Introductions
- c. Awareness of Differences Between Locations

Less Structure
- a. No Clearly Defined Goals
- b. No Clear Agenda
- c. Lack of Clarity of Terminologies

Less Dialogue
- a. Sites Speak at Same Time
- b. No Opportunities to Build Social Ties Among Participants
- c. Lack of Awareness of Differences Between Locations

**Transactional Distance – Increased**

*Figure 1. Transactional Distance Videoconferencing Model.*

Examining these communications from the network perspective also provides several theories that aid in decreasing the transactional distance among learners in virtual environments. Studies on similarity have been conducted to review homophily theory in groups (Katz et al., 2005), since this theory is a predictor of how network ties
will be created. With computer-mediated communication technologies, participants from vastly differing places can interact and communicate, which may reduce the level of homophily in the group (Bisgin, Agarwal, & Xu, 2011). Studies also have been conducted to examine the importance of similarity of location (Yuan & Gay, 2006), which is a new dimension brought out through computer-mediated communications. Providing clear guidelines that will work to lessen the chance of miscommunication and to facilitate norm development within the group is important (Slagter van Tryon & Bishop, 2009). Depending on the composition of participants, new virtual classes or organizational groups may possess only weak ties at first, since participants may or may not have existing relationships before the sessions (Granovetter, 1973). Therefore, finding methods of building and guiding social networks among the virtual group also is important (Haythornthwaite, 2005). A study was conducted in distance learning that concluded faculty who use Facebook and provide personal information about themselves with their students have stronger ties to the students and were rated by the students as more credible in their teaching (Mazer, Murphy, & Simonds, 2009). This seems to indicate that students are seeking ties to their faculty and feel more confident in their faculty, even when the communication is electronic. Studies of the impact of technology on the strong or weak ties of an organization will continue to be important to aid organizations as they change and adapt to new methods of communications and operations (Pickering & King, 1995).

To address this sense of distance that participants feel in computer-mediated communications, the leaders of these sessions must work to create a more engaging and effective communication environment (Peterson, 2004). Research has shown that some
sense of distance can be eliminated when the communication is synchronous (Falloon, 2011; Schullo, Hilbelink, Venable, Barron, 2007), helping to strengthen the case for including videoconferencing in virtual work and class settings. While many factors detailed above will influence the effectiveness of a virtual group or class, a 2006 study by Timmerman and Scott (2006) found that the features for which the groups had no control, such as differing geographical location and time zones, did not seem to influence the groups’ effective outcome.

Change Management Theories

Networking communication perspective and studies of transactional distance soundly show the importance of communication and engagement between participants in groups, whether the groups meet face-to-face or in a virtual environment. Current data also indicate the expected growth and the demands requiring increasing utilization of computer-mediated communications to achieve organizational goals. As organizations increase their implementation of videoconferencing technologies and incorporate these changing methods of communication and collaboration, careful planning must be utilized to aid the change process. Change is challenging to accomplish in any setting, but several theories of change exist that, when reviewed, are specifically beneficial while implementing new technical capabilities that disrupt current methods of business and teaching. Of particular importance to this research is a study conducted by Shoham and Perry (2009). They closely examined two higher educational systems in Israel that were both implementing new E-learning programs. From their study they developed a model for universities to follow when implementing change. This model is known as the “KM-M-CM,” which they defined as “Knowledge Management as a Mechanism for Change
"Management.” While their model is applied to technology changes affecting the entire organization, if the management of knowledge serves as a mechanism for change, this also might be applicable to this study.

The Change Theory developed by Kurt Lewin established a change model identifying three distinct stages necessary for change to occur (Wirth, 2004): the unfreezing stage, the change or moving stage, and the refreezing stage (Cryer & Elton, 1990; Wirth, 2004). In the unfreezing stage, an individual or organization must decide they want or need to change. Lewin takes into account the importance of an organization or the individual’s readiness for change as the first step in the process. One has to want to make a change, and recognize a need for change, for this critical Unfreezing Phase. One also must be willing and ready to change before change can occur (Narayan, Steele-Johnson, Delgado, & Cole, 2007). John Kotter, a leader in the field of change management, advises organizations to develop a real sense of immediacy to promote the need for change (Heffes, 2009).

In the second phase, identified by Lewin as the Change Phase, the actual change process occurs through the implementation of steps being taken to begin a new process, procedure, or belief (Wirth, 2004). However, unless changes are maintained and become well established as the new norm, they may not last. In phase three, the Refreezing Stage, the individual or organization works to ensure the changes become a permanent part of the organizational culture. This final phase, often overlooked, is fundamentally critical to maintaining the adoption of change and highlights the work required to make the change a permanent part of the organization or individual behavior. The refreezing phase is crucial to the change process. Any change that has occurred must be solidified
within the culture to maintain the new established standards (Beverland & Lindgreen, 2007). Leadership needs to be aware of the time and efforts required to refreeze the change, even when constrained by having to move to another needed change quickly. The entire three-stage process must be completed for each initiative.

Leadership styles were deemed to be key elements within the critical factors identified that create a climate conducive to change. Because of the value of social support in creating environments conducive to change, it is not surprising that research has found that the leaders who create this type of organization typically possess a more transformational style of leadership, as opposed to a transactional style (Brookes, 2011; Michaelis, Stegmaier, & Sonntag, 2010). Transformational leaders instill a higher level of social support for employees, which leads to an organization more willing to adapt to change. Supported employees feel they are valued and more bonded with the organization (Dvir, Kass, & Shamir, 2004), which aids in change implementation. Supported employees can focus on personal change and will be inspired to look for innovative new methods and procedures to improve the organization, knowing they can make suggestions or try new procedures without fear of repercussions from failures (Ahuja & Thatcher, 2005). Change on the personal level ultimately leads to organizational change. Because true adoption of any change has to occur at the individual level, the real leadership for change needs to be driven by mid-level management. Leaders at the top create the vision and the goals for the overall organization, but operational management work more closely with employees and have more of an impact on change (Beverland & Lindgreen, 2007; Dvir et al., 2004).
Lewin's Three-Stage Model of Change also is highly applicable when discussing any type of new implementation in technology (Wirth, 2004). By acknowledging the importance of the unfreezing stage, information technology personnel can work more effectively with employees by focusing on the value-added to everyday tasks, such as through the new use of synchronous online communication tools. Edgar H. Schein (1996) examined resistance to change in an article in which he elaborated from the psychological standpoint that changes may be difficult to enact because, when the need for change is discussed, individuals immediately begin an effort to resist, since the change process may be difficult. An article by John Edmonds (2011) referenced the fear employees may feel when facing a changing environment. Understanding and dealing with these barriers to the change is essential for leaders if they are to be successful in eliminating them (Eisenbach, Watson, & Pillai, 1999; Schein, 1996). A practical application of Lewin's theory was studied among a group of nurses who were being asked to adopt a new information technology device. The three stages were clearly identifiable, beginning with how the nurses worked from their initial unwillingness to try the new technology to the point at which they were willing to try it out. Next, they moved from this unfreezing stage to the change stage where they implemented the new technology and began using it. In the refreezing stage, they began consistently using the technology (Ting-Ting, 2006).

Complementing Lewin’s Three-Stage Model of Change, Martin Fishbein, a communications professor, and Icek Ajzen, a psychology professor, developed the Theory of Reasoned Action. This theory was developed as a revision of their earlier work, which was called the Theory of Planned Behavior (Gold, 2011). The Theory of
Reasoned Action provides the theoretical foundation that an individual’s actions can be predicted by their beliefs or intentions, along with their attitude and societal norms (Ahuja & Thatcher, 2005; Becker & Gibson, 1998; Gold, 2011). This theory has been applied in many research situations and consistently has been a reliable predictor of intention (Becker & Gibson, 1998; Sheppard, Hartwick, & Warshaw, 1988). A practical example in higher education was conducted with faculty members of a university in Taiwan to research whether the Theory of Reasoned Action could be utilized to determine faculty intentions to teach online courses. The study was conducted with faculty members who taught courses in Human Resources and were employed full time with the university. The level of faculty experience in teaching online courses was not a factor in selection. This empirical study revealed that the theory served as a solid indicator on faculty intention and, therefore, worked well in this application (Tzy-Ling & Tzu-Jung, 2006).

The Theory of Reasoned Action is important because it examines not only an individual’s choice to engage in an action, but also looks at the process of how the choice is made (Becker & Gibson, 1998), which provides more depth and insight into how Lewin’s unfreezing stage can be implemented. Both Lewin's Change Theory and the Theory of Reasoned Action are valuable in an organizational setting. Individually, both provide solid theoretical foundations for creating environments that foster and aid changes in the organization. Together, the theories strengthen one another and deepen the insight into the change process. The Theory of Reasoned Action fits well with Lewin's model as the first stage of change, which begins with a need for an intention for change to occur.
Not everyone welcomes changes or perceives the need for change in the same manner. Thus, Lewin's first stage of his model takes an in-depth look at how to initiate change and reviews two primary rationales hindering the start of the change process. Individuals may resist because of self-defense mechanisms that inhibit the desire for change; also, there may be resistance because the changes affect the organizational norms that are a strong part of the organizational environment. The Theory of Reasoned Action is beneficial to apply at this stage in the change process to help create the type of environment in which change is the intention and can occur. The theory also deals with the individual behavior and opinions, as well as the societal norms influencing the change process. Not only do societal norms factor into both theories at the beginning of the change process, but societal norms also are a factor in the refreezing stage. The definitions, thoughts, or processes must become a part of a new organizational norm to become a lasting part of the environment.

One study applied the Theory of Reasoned Action to students’ willingness to participate in a distance education program. The researchers in this study, Becker and Gibson (1998), also found the theory worked well to serve as a reliable indicator of participation in the program. According to a study by Ahuja and Thatcher (2005), the theory supports the theoretical foundation that employee beliefs will serve as predictors for employee actions. However, their findings suggested that additional workplace factors, such as work load and autonomy, have a significant influence on actual employee behavior as well. The researchers felt the results could be applicable in a variety of discussions on how to influence employee behavior and organizational environments (Ahuja & Thatcher, 2005).
Motivation is a key factor in the unfreezing process, which means that leadership must understand what motivates the people within the organization. The level of employee workload and the level of personal control employees have in their positions are significant factors in whether they feel comfortable with changing their environment (Ahuja & Thatcher, 2005; Jimmieson, White, & Zajdlewicz, 2009). Employees need to feel they have a manageable workload and are more comfortable if they possess some level of autonomy and decision-making ability. This comfort level in the work environment has been identified as a key factor for promoting innovation in employees (Ahuja & Thatcher, 2005). While many varying factors influence motivation, one study revealed five factors that most effect motivation: the change’s impact on society, on the customer, on the company, on the team, and on the employee (Price & Lawson, 2003).

Motivation of employees can be challenging. In an article Dr. Jeswald W. Salacuse (2007) contended that negotiation was an important skill when working to motivate employees. The traditional wisdom stating that leaders should possess charisma and vision for individuals to choose to follow their direction is simply not enough. Effective leaders know their followers and know what motivates them, allowing them to negotiate more effectively.

The management of change “refers to the making of changes in a planned and managed or systematic fashion” (Nickols, 2010, p. 2). However, because changes can occur due to internal influences or external influences, the management of change also would include a second definition of “the response to changes over which the organization exercises little or no control” (Nickols, 2010, p. 2). Managing these changes, which take organizations in new directions, can create stressful and challenging
environments. Therefore, planning and coordinating how changes are implemented is important for organizations to succeed. The authors of one article provided several models for change management that organizations can follow (Shoham & Perry, 2009). While they also noted differences between change management in business environments versus change management in educational organizations, these models developed from the business environment can be adapted to educational institutions (Shoham & Perry, 2009). The models include the Dynamic Stability model; Problem Solving model; Interactive, Strategic Planning model; Eight Stage model; and Dynamic Organizational Systems model, all containing the elements of providing clearly outlined and defined phases for implementing changes. All models emphasize proper planning before implementation.

To have the best chance for success, any change management plan should include the end-goals for the change and ensure they are clearly defined from the beginning (Whitehead, 2001). An article by Armenakis and Bedeian (1999) examined the theories and research of the 1990s related to organizational change. Common themes found among these theories relate to content, contextual, and process issues. Prominent developers in content research included Burke-Litwin and Vollman, whose models examined what is needed internally to plan and evaluate change (Armenakis & Bedeian, 1999). To plan a change process well, the result must be determined (Armenaki & Bedeain, 1999). Research shows that clearly identifying where the organization needs to be after the change is a major component in its success and implementation. The earlier mentioned study of university faculty in Taiwan also indicated the importance of social attitude as a predictor of intention. Not only do societal norms factor into both theories at
the beginning of the change process, societal norms also are a factor in the refreezing stage. The definitions, thoughts, or processes must become a part of a new organizational norm to become a lasting part of the environment (Tzy-Ling & Tzu-Jung, 2006).

**Technology Implementations Theories**

The Diffusion of Innovations Theory discusses the starting point for innovations and how they are implemented in organizations. Initially, innovations were thought to originate from a central location and then spread through the organization. Over the years the theory evolved that innovations stem from a more decentralized level and, in actuality, exist as a hybrid of the two views (Rogers, 2003). While there are times when technology implementations occur quickly, organizations would do well to take their time to ensure they have reviewed all aspects of the implementation, including intended and unintended consequences. If changes are implemented too quickly without proper planning, they do not work well and user adoption will fail (Rogers, 2003). Emotions play a significant factor in information technology adoption, making it even more critical for the users to have a positive experience from the beginning (Beaudry & Pinsonneault, 2010).

The individuals considered early-adopters are an important group with whom to work when implementing new technologies. These early-adopters are viewed as the leaders, as they are among the first to begin using new technology and are then asked to provide input to the next groups of adopters (Rogers, 2003). Early-adopters openly embrace the new methods for collaboration and are less resistant to change.

In videoconferencing rooms, as with any information technology innovation, two interested parties exist – the technology implementers and the end-users. Factors that
impede videoconferencing success and IT innovations include the lack of understanding of needs and requirements on both sides of this dyadic and flawed communication between the groups (Kettinger & Lee, 2002).

When technology implementations are planned, the focus should not be on the technology itself. Technology is implemented for specific reasons, and those reasons should be emphasized (Miner, 2009). Often in videoconferencing implementations are deemed a success if all of the technical components work and connections can be made, without any understanding on how the technical configuration met the users’ needs. Organizations may increase success with technology initiatives if they are not viewed as technology implementations but regard them as “change initiatives” (Miner, 2009, para.7). Because the success of a videoconferencing room is directly tied to both technology and user success, a more holistic approach is needed. One study found significant issues with information technology implementations when the users and the IT department were not working toward the same goals (Snyder, Marginson, & Lewis, 2007).

In this context, adoption is defined “as the decision to accept, or invest in, a technology” (Dasgupta, Granger, & McGarry, 2002, p. 87). The term invest does not refer to simply the financial investment to purchase a system, but refers also to the time and effort of organizational staff to incorporate new technology into their work processes. Therefore, the Technology Adoption Model considers the perceptions of the end-users regarding the ease of using a new technology and their perceptions on how valuable it will be before adoption occurs (Legris, Ingham, & Collerette, 2003). These are the two key components of the theory that were developed building on the earlier Theory of
Reasoned Action (Legris et al., 2003; Venkatesh, 2000). A study in 2011 also found users’ perceptions on ease of use to be a significant factor in technology adoption (Lee, Hsieh, & Hsu, 2011). Therefore, access to training opportunities is important for users’ adoption, even if the technology is considered easy to learn.

Current discussions in the videoconferencing industry have debated the need for training, since newer control systems are more simplified and are thought to be intuitive. However, nothing is easy if one does not know how to use it. Successful implementations should include training opportunities for users (Miner, 2009). If changes can be designed for implementations that take into account employees’ views, which are then used to emphasize the value brought to the individual employee, the implementation is likely to be more successful (Nichols, 1981). The same study also detailed three areas of knowledge identified as important to implementing a successful change in an organization (Nichols, 1981). These three areas included gaining knowledge about an individual’s daily work activities, communications with co-workers around them and their environment, and their attitudes toward the job duties and communications (Nichols, 1981). Users’ perceptions of the responsiveness of the information technology staff working to implement new initiatives also will be a critical factor in the adoption rate (Gefen & Ridings, 2002).

While employee resistance can be a significant barrier to new technology implementations, not all resistance is bad. If genuine problems exist, then legitimate resistance will, and should, occur (Lapointe & Rivard, 2005). Familiarity with the technology will reduce the resistance. One study of students enrolled in a distance learning class conducted via interactive video (ITV) technology found that student
satisfaction increased as the number of courses taken by ITV increased. This seems to indicate that, while students are initially uncomfortable around new technologies, an increased familiarity improves their view on the course technology (Royal, Bradley, & Lineberry, 2004).

Summary

Communications and meeting management are challenging in face-to-face environments. With the addition of technology to the room environment, the challenges are even greater. By applying the Theory of Transactional Distance to computer-mediated communications, some of the additional challenges and issues can be alleviated or minimized. Networking perspectives on group dynamics also can provide theoretical background to strengthen and improve the virtual collaborations within the videoconference. These environments continue to evolve. Technology implementation theories, such as the Technical Acceptance Model and Roger's Diffusion of Innovation, can help when implementing new designs in videoconferencing technologies. Traditionally, technical implementations have focused on the success of the videoconference primarily from the technology paradigm, but the view should change to incorporate whether the collaboration was provided at the level needed. Change management theories can provide theoretical background to assist with changing the design of rooms strictly from a technology view to one that incorporates more of the participant collaboration view.
CHAPTER III: METHODOLOGY

This chapter will provide methodological details of the study including descriptions of the research design, data collection methods, survey administration, and data analysis. It also describes the purposeful sampling utilized to administer the technical survey and the convenience sampling utilized for the survey of end-users. Independent and dependent variables will be identified for the research questions and survey questions will be matched with the appropriate research question.

Introduction

Two significant components are present in a successful videoconferencing session. First, all videoconferences have technical services that must work to provide quality audio and video; otherwise, participants cannot communicate between sites. For the information technology specialists who support these unique classrooms and conference rooms, this is where the primary interest is focused. Connections have to be made; firewalls have to be traversed; speakers, microphones, and cameras must be turned on, otherwise participants cannot see and hear each other. However, the second component to videoconferencing, which is as important, is whether the participants can successfully collaborate within the meeting. It is not enough just to have a camera in the room if the camera shot provides a bad angle on the remote participants. Thought must be given to where the camera is located, how intuitive it is for the speaker to look in the right location, and what type of view the camera provides for remote participants. Concurrently, microphones may be installed, but location of the installation is important to provide the best sound quality for all participants. How presenters will actually use the room should determine the type of microphone configuration. One complaint voiced in
videoconferencing settings are end-users who feel they cannot connect well with remote participants because they see only the images as small squares on a screen. This is often called the “Hollywood Squares” screen layout. While most videoconferencing systems allow for changes in the screen layout, if the end-users and the technical support staff do not work together, the screen layout selected may not meet the needs of the participants. This type of complaint makes it apparent there is a disconnect between the technology support and what the end-users truly desire and need (Kettinger & Lee, 2002).

Videoconferencing technologies are unique in information technology areas precisely because they consist of two completely separate areas of function. A videoconferencing session may work technically well but still have failed to provide the collaborative environment the participants needed. Both components have to come together for a truly successful videoconferencing session. This is often referred to in terms as the technical or services side, coupled with the human-factor or meeting side. The Transactional Distance Theory, while developed as a pedagogical theory, also can be applied when attempting to articulate the success of the collaboration occurring. Structure and dialogue are occurring at differing levels in the videoconferencing sessions.

The purpose of this study was to examine the level of collaborative aspects incorporated into the technical room design of a videoconferencing facility by information technology specialists. Data were collected from a survey consisting of Likert-scaled questions, as well as descriptive questions on participants and their organizations, so that correlation between the relationships could be analyzed. To provide more insight into the possible correlations, interviews were conducted with participants who were willing to be interviewed on the subject matter. These interviews
were semi-structured, with selected questions asked of all interviewees and open-ended questions asked to provide more in-depth responses. This mixed-method mode of research provides for richer insight into the study topic.

This study examined the relationship between videoconferencing room design and perceptions on collaboration in a videoconference. Research questions focused on how the levels of videoconferencing support staff, their levels of knowledge provided through learning opportunities and experience, and age and gender of videoconferencing support staff impact the implementation of critical technical characteristics. Concurrently, this study examined how these critical technical aspects in videoconferencing room design impact the end-users’ perceptions on the quality of collaboration within videoconferencing rooms using empirical data drawn from the survey. Last, the study compared how often critical collaborative room characteristics, as reported by end-users, were incorporated into the videoconferencing room design, as reported by the videoconferencing professionals.

The research design included two separate surveys focusing on the two primary research questions. One survey was administered to videoconferencing support professionals and one was administered to end-users of videoconferencing.

While videoconferencing implementations have increased and industry experts predict “explosive growth in the use of videoconferencing as a fundamental tool for businesses to enhance communication and collaboration” (Polycom, 2012, p. 1), Forrester Research released a report discussing how the rate of implementation varies among organizations (Forrester, 2011). Participant satisfaction in videoconferencing, however, has lagged behind the number of implementations (Coventry, 1994). It is hoped that
greater insight on how technical characteristics of room implementation directly impact collaboration will lead to improved room designs and increased participant satisfaction.

**Research Questions**

The following research questions guided this study:

**Research Question 1:** How do the characteristics of videoconferencing professionals relate to the overall quality of collaboration sessions, controlling for background demographic variables?

- **Research Question 1A:** Does the level of staffing of videoconferencing professionals units affect the level of collaborative capabilities incorporated into room design?
- **Research Question 1B:** Does the level of knowledge, provided through learning opportunities and experience, affect the level of collaborative capabilities incorporated into room design?
- **Research Question 1C:** To what extent are the characteristics of videoconferencing professionals related to the level of collaborative capabilities incorporated into room design?

**Research Question 2:** Does improved feeling of closeness increase participants’ perceptions on the quality of collaboration?

- **Research Question 2A:** Does the view of remote participants impact end-users’ perceptions on the quality of collaboration?
- **Research Question 2B:** Does the audio system affect end-users’ perceptions on the quality of collaboration?
Research Question 2C: Does gaze angle in videoconferencing rooms impact end-users’ perceptions of the quality of collaboration?

**Research Question 3:** How did the answers between the two separate surveys compare?

Research Question 3A: Are there differences in the perceptions between the videoconferencing professional and end-users on how often important collaborative room characteristics are incorporated into the videoconferencing room designs?

**Research Design for Technical Survey**

Because of the specific nature of the study, this survey was administered to participants selected through purposeful sampling: videoconferencing professionals (Patton, 2002). This survey population of videoconferencing professionals was identified based on membership in a national videoconferencing organization consisting of approximately 540 videoconferencing professionals and representing all levels of implementation and support of videoconferencing systems. Members represent a variety of industries including banking, legal, education, pharmaceuticals, telecommunications, and others. While most of the members of this organization are located throughout the United States, some are international, residing in countries such as Canada, Switzerland, the United Kingdom, Australia, and Israel.

Purposeful sampling provides for deeper insight into a smaller subject area and was, therefore, used for this study into videoconferencing design. The study will not be as generalizable because of the small study sample; however, it is not intended to be. This analysis is intended to provide more in-depth information on videoconferencing room design and will benefit those specialists working in this specific field. Because of
the small number of members in the organization, a comprehensive sampling was used (Wiersma & Jurs, 2009). This comprehensive sampling is possible because all members of the organization have very specific and unique industry knowledge and expertise in this field that directly relates to the survey materials.

**Pilot Study of the Videoconferencing Technical Survey**

A pilot study was conducted to test the new survey instrument developed to measure key aspects of collaboration within videoconferencing room design. The pilot survey was administered by sending the instrument out to a group of 30 participants, randomly selected from a statewide videoconferencing organization. This organization consists of individuals in a variety of occupations including legal, educational, telehealth, government, and others. These individuals are responsible for implementing and supporting videoconferencing technologies and mirror the composition, by industry and position, of the actual survey population (Wiersma & Jurs, 2009). The pilot survey instrument also was sent for evaluation to a few industry experts who specialize in the collaborative or human-factors aspects of videoconferencing. After feedback was received from the pilot study, the survey was modified to improve the overall quality of the instrument in terms of validity and reliability before being administered to the national group of videoconferencing professionals.

**Measures**

The survey was used to collect data from videoconferencing professionals and was administered electronically. One argument against the use of email surveys is that researchers will not reach those who do not have email accounts (Ilieva, Baron, & Healey, 2002). However, the survey population works in an information technology area
and is actively subscribed to the email lists; therefore, this will not be an issue. The survey consists of Likert-type scaled questions regarding their knowledge on videoconferencing room design, their level of exposure to learning opportunities, and the level of video-conferencing support within their organizations. Descriptive questions also were asked of the participants.

**Variables**

**Independent variables.** The independent variables for the technical survey are the level of staffing of videoconferencing support units as compared to the number of supported rooms; the level of knowledge provided through learning opportunities and experience; and the characteristics of videoconferencing professionals.

**Dependent variable.** Dependent variables for this study are the technical aspects of the survey participants’ videoconferencing rooms. In particular, three specific aspects of technical configurations that are tied most directly to users’ perceptions on collaboration were studied: gaze angle, audio systems, and views of remote participants. A composite score was created by summing seven variables related to these perceptions of collaboration in videoconferencing rooms, which was then used for the dependent variable. The relationships between the variables are illustrated in Figure 2.
Demographics

Demographic questions were asked to provide information on the organizations in which the videoconferencing professionals are employed and to provide demographics of the videoconferencing professionals including age, gender, and primary role in their organization.

Level of Videoconferencing Support Staffing

Survey questions were asked regarding the number of employees in their organization, number of employees in the IT division or support unit, number of employees directly supporting videoconferencing within their organization, and the
number of videoconferencing enabled rooms within the organization. Response boxes were open, so answers could be specific, if known. Answers were left blank if unknown. The ratio of videoconferencing support staff to the number of videoconferencing enabled rooms was calculated to in order to examine the effect of staffing levels on the level of collaborative capabilities incorporated into room design.

**Level of Knowledge on Collaborative Videoconferencing Room Design Gained through Exposure to Learning Opportunities and Experience**

Survey questions were asked that examined how recently videoconferencing professionals were involved in a videoconferencing room installation; what educational opportunities were available for them to learn about new technologies, concepts, and available features in the industry; and how recently they had participated in conference or training opportunities.

**Videoconferencing Room Design Questions**

**Gaze angle.** Two questions were asked focusing on determining the perceptions of importance of gaze angle in videoconferencing room design.

**Audio.** Two questions were asked focusing on determining the perceptions of importance on two different types of audio systems

**View of remote participant.** A series of questions were asked regarding the placement and size of the viewing monitors or screens, and the size of the image on the viewing monitor or screen. Each of these factors combine to provide the remote participant view.

One question was asked that related to the overall impression of the videoconferencing room design.
Data on overall room characteristics also were collected to provide demographic information on the actual videoconferencing rooms. A list of the most commonly used technologies was provided, along with three open-response boxes for additional technologies not listed. Because no standard definition exists for the equipment or functionality in a videoconferencing room, this question will help to provide a basis for developing a clearer definition of a videoconferencing room.

**Research Design for End-User Survey**

Because of the specific nature of the study, this survey was administered to participants selected through purposeful sampling: faculty who are currently teaching distance learning courses via videoconferencing technologies at a public university.

**Pilot Study of the End-User Survey**

A pilot study was conducted to test the new survey instrument developed to measure key aspects of collaboration within videoconferencing room design from the end-user perspective. The pilot survey was administered to faculty members currently teaching distance learning courses via videoconferencing technology at a university. The pilot survey instrument also was sent for evaluation to a few content experts who are more experienced with videoconferencing usage in distance education courses. After feedback was received from the pilot study, the survey was modified to improve the overall quality of the instrument in terms of validity and reliability, before being administered to the faculty members. The survey was used to provide information on room design from the end-user perspective. The end-user survey is being piloted and it is anticipated that the survey will be administered to a larger group of end-users in a future study.
Measures

The survey was developed to collect data from end-users of videoconferencing rooms and was administered electronically. The survey instrument consisted of Likert-type scaled questions regarding participants’ perceptions of closeness in videoconferencing rooms and whether it affects their satisfaction with the videoconferencing session. Descriptive questions also were asked of the participants. To provide more insight, a few interviews were conducted with participants who self-selected to be interviewed. These interviews were semi-structured and, when possible, were conducted utilizing desktop-based videoconferencing technologies, which allowed for participants to be interviewed conveniently from their locations. This mixed-method mode of research provided for greater insight into the study topic.

Variables

Independent variables. The independent variables for the end-user survey were the participants’ perceptions on views of remote participants, audio system, and gaze angle.

Dependent variable. Six variables related to the perceptions of closeness in videoconferencing classes, and composite scores were created for the three specific research areas. An overall composite score was created by summing all six variables related to perceptions of closeness in videoconferencing classes, and this composite was used as the dependent variable. The relationships between the variables are illustrated in Figure 3.
End-User Research Questions

Demographic questions were asked to provide background information on the end-users’ experience with teaching via videoconferencing technologies, along with age range and gender.

Gaze angle. A 5-point Likert scale was used with one question to serve as an indicator of whether gaze angle in a videoconferencing room affects feeling of closeness and end-user satisfaction with the videoconferencing session. Responses available were “Strongly Agree,” “Agree,” “Neutral,” “Disagree,” and “Strongly Disagree.”
Audio. A 5-point Likert scale was used with a series of questions to serve as indicators of whether the audio system in a videoconferencing room affects feeling of closeness and end-user satisfaction with the videoconferencing session. Responses available were “Strongly Agree,” “Agree,” “Neutral,” “Disagree,” and “Strongly Disagree.”

Participant viewing options. A 5-point Likert scale was used with a series of questions to serve as indicators of whether participants’ viewing capabilities affect feeling of closeness and end-user satisfaction with the videoconferencing session. Responses available were “Strongly Agree,” “Agree,” “Neutral,” “Disagree,” and “Strongly Disagree.”

Overall Perceptions of Videoconferencing Room Design. A 5-point Likert scale was used with two questions to serve as indicators of participants’ overall perceptions of the feeling of closeness and satisfaction with the videoconferencing session. Responses available were “Strongly Agree,” “Agree,” “Neutral,” “Disagree,” and “Strongly Disagree.”

One open-ended question was asked to allow for additional comments from survey participants.

Research Design for Cross-Survey Comparisons

For Research Question 3, “Are there differences in the perceptions between the videoconferencing professional and end-users on how often important collaborative room characteristics are incorporated into the videoconferencing room designs?,” a series of
questions were included on each survey that are closely matched, and a comparison of the composite answers was correlated between the two surveys. These questions are outlined in Table 1.

Table 1

Between Surveys Comparison Questions

<table>
<thead>
<tr>
<th>Question Relates to:</th>
<th>Technical Survey</th>
<th>End-User Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>For Viewing of Remote Participants:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placement of Display</td>
<td>#14A</td>
<td>#6B</td>
</tr>
<tr>
<td>Size of Display</td>
<td>#14B</td>
<td>#6B</td>
</tr>
<tr>
<td>Size of Image on Display</td>
<td>#14C</td>
<td>#6C</td>
</tr>
<tr>
<td>Audio:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pan-Tilt-Zoom Cameras Controlled by Microphones</td>
<td>#14D</td>
<td>#6F</td>
</tr>
<tr>
<td>Gaze Angle:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placement of Presenter Camera</td>
<td>#14F</td>
<td>#6G</td>
</tr>
</tbody>
</table>

Analysis

Collected data were entered into SPSS. Descriptive analysis was conducted first to determine if each item had normal distribution. There was no skew of the survey items that required adjustments to the data. To study the relationships between the independent and the dependent variables, a hierarchical multiple linear regression model was used that tested for Research Questions 1A-1C. This regression model consisted of three sequential blocks with variables within each step entered simultaneously. Correlational analysis was used on Research Questions 2A-2C. Composite scores were created for the
three specific research areas, and the overall composite score was then created by summing all six variables related to perceptions of closeness in videoconferencing classes. An independent samples t-test was conducted to compare videoconferencing professionals’ perceptions and end-users’ perceptions on the implementation levels of the three key components of technical design for Research Question 3. A comparison of the means was examined on questions regarding perceptions on viewing of the remote participants, the audio system, and gaze angle.

While videoconferencing usage grows, user satisfaction has not always increased accordingly. Often, there is talk of a separation between Information Technology and organizational needs (Kettinger & Lee, 2002). It is anticipated that the results of this study will provide greater insight into how videoconferencing rooms are designed and the level of collaborative aspects required by the end-users. By identifying whether disconnects exist between the technical side and the end-user side, procedures can be developed to help narrow this divide. The focus of videoconferencing should be on the collaboration that occurs within the room, not on the room itself (Miner, 2009). When this focus is lost, user satisfaction will be affected. Improved satisfaction with the collaboration may lead to increased adoption of the technology, since projections on usage and adoption have not always been realized.
Table 2

**Survey Questions as Related to Variables**

<table>
<thead>
<tr>
<th>Independent Variable IV &amp; Type</th>
<th>Question #</th>
<th>Dependent Variable DV &amp; Type</th>
<th>Question #</th>
<th>Data Analysis</th>
</tr>
</thead>
</table>
| RQ1A VC staffing levels  
Type: Ordinal | Q9, Q10 | Level of collaborative capabilities in room design | Composite (14A, 14B, 14C, 14D, 14E, 14F, 14G, 16) | Hierarchical Multiple Linear Regression |
| RQ1B Level of knowledge provided through trainings and experience  
Type: Ordinal | Q5, Q6, Q11, Q12, Q13 | Level of collaborative capabilities in room design | Composite (14A, 14B, 14C, 14D, 14E, 14F, 14G, 16) | Hierarchical Multiple Linear Regression |
| RQ1C Characteristics of VC staff  
(age and gender)  
Type: Ordinal | Q2, Q3 | Level of collaborative capabilities in room design | Composite (14A, 14B, 14C, 14D, 14E, 14F, 14G, 16) | Hierarchical Multiple Linear Regression |
| RQ2A View of remote participant  
Type: Ordinal | 6A, 6B, 6C, 6D | Overall satisfaction with collaboration | Composite (6J, 7A, 7B, 7C, 7D) | Correlation |
| RQ2B Audio system  
Type: Ordinal | 6H, 6I | Overall satisfaction with collaboration | Composite (6J, 7A, 7B, 7C, 7D) | Correlation |
| RQ2C Gaze angle  
Type: Ordinal | 6G | Overall satisfaction with collaboration | Composite (6J, 7A, 7B, 7C, 7D) | Correlation |
| RQ3 Comparison of surveys  
End-User Survey: 6A, 6B, 6C, 6D, 6G |  | Overall satisfaction with collaboration | Composite (6J, 7A, 7B, 7C, 7D) | Correlation |

Future areas of study, building from the initial data obtained with this survey, would be to survey the videoconferencing users at the same or similar organizations to
better determine if the technical staff and the users are closely aligned with what features and capabilities are important for these collaborative environments and to ensure the user requirements are being implemented by IT.
CHAPTER IV: RESULTS

This study examined the relationship between videoconferencing room design and perceptions of collaboration in a videoconference. Research Question 1 focused on how the videoconferencing professional staff and their opportunities to gain knowledge of videoconferencing room design affect collaborative technical characteristics of rooms. Concurrently, the study examined how these critical collaborative technical aspects in videoconferencing room design influenced the end-users’ perceptions of the quality of collaboration within videoconferencing rooms using empirical data drawn from surveys. Last, the study examined how often specific collaborative room characteristics, as reported by end-users, were incorporated into the videoconferencing room design. A comparison was then made of how often these same characteristics were incorporated into the videoconferencing room design, as reported by the videoconferencing professionals. This chapter is organized into four sections: results from videoconferencing technical survey, results from the end-user survey, comparison of videoconferencing professionals and end-user perceptions, and findings from interviews with both groups. Each of the first three sections contains research questions associated with specific data analysis, descriptive information about the data, and results from an analysis of multiple regression, correlation, or independent t-tests.

Results from Videoconferencing Technical Survey

Because the field of videoconferencing support is highly unique and specific, a questionnaire was designed to focus on technical aspects of the videoconferencing environment and specialists’ concerns based on purposeful sampling. Purposeful sampling is found to provide for deeper insight into a smaller subject area. This analysis
is intended to provide more in-depth information on videoconferencing room design and will benefit those specialists working in this specific field. After conducting a pilot study of the new survey instrument and modifying some aspects of the survey based on content-expert feedback, the questionnaire was administered through the Qualtrics online survey research system.

**Findings Related to Research Question 1**

This section addresses the analysis of Research Question 1: How do the characteristics of videoconferencing professionals relate to the overall quality of collaboration sessions, controlling for background demographic variables? For this investigation, the current study explored the following specific questions:

Research Question 1A: Does the level of staffing of videoconferencing professionals units affect the level of collaborative capabilities incorporated into room design?

Research Question 1B: Does the level of knowledge, provided through learning opportunities, and experience, affect the level of collaborative capabilities incorporated into room design?

Research Question 1C: To what extent are the characteristics of videoconferencing professionals related to the level of collaborative capabilities incorporated into room design?

In the Technical Survey, the level of collaborative capabilities in room design was reflected in a series of 5-point Likert scale items, and the composite score of the participants’ responses to these items served as the dependent variable, which consists of three primary technical components. The three research-based components include (a)
how well the remote-participants can be seen, (b) level of gaze angle for the local camera, and (c) the type of audio system selected for the room.

Demographic Information of Participants for the Technical Survey

Table 3 presents frequency information for demographic variables such as primary industry and videoconferencing role associated with Research Questions 1A-1C. Among the five categories of primary industry, the size of staffs from educational organizations was the largest (41.1%); 25.45% of respondents were from business, while 3.6% were from government organizations. Respondents reported working in management roles (34.55%) and conference operations (18.18%), and 12.73% reported working either as conference engineers or in design and operations. Slightly more than 23% of respondents were female, with males accounting for more than 76% of the surveys completed. Forty-one of the respondents indicated they possessed a bachelor’s degree, 19.57% had either a master’s degree or an associate degree, and 19.57% held either an industry certification or other relevant certification.

Table 4 presents a median of four videoconferencing support staff per organization, with a median of 32.50 videoconferencing enabled rooms at each reporting location. The ratio videoconferencing staff to videoconferencing enabled rooms indicated a mean of 12.88%. Caution should be used when looking at these numbers, since the organizations represent a wide range of rooms and employees.
Table 3

Demographics Information on Primary Industry, Videoconferencing Role, Age, Gender, and Type of Education

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>2</td>
<td>(3.64)</td>
</tr>
<tr>
<td>Educational</td>
<td>23</td>
<td>(41.82)</td>
</tr>
<tr>
<td>Business</td>
<td>14</td>
<td>(25.45)</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>(29.09)</td>
</tr>
<tr>
<td>Videoconferencing Role</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conference Engineer</td>
<td>7</td>
<td>(12.73)</td>
</tr>
<tr>
<td>Design and Integration</td>
<td>7</td>
<td>(12.73)</td>
</tr>
<tr>
<td>Conference Operations</td>
<td>10</td>
<td>(18.18)</td>
</tr>
<tr>
<td>Management</td>
<td>19</td>
<td>(34.55)</td>
</tr>
<tr>
<td>Technician</td>
<td>4</td>
<td>(7.27)</td>
</tr>
<tr>
<td>Vendor</td>
<td>2</td>
<td>(3.64)</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>(10.91)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 – 30</td>
<td>3</td>
<td>(5.45)</td>
</tr>
<tr>
<td>31 – 40</td>
<td>9</td>
<td>(16.36)</td>
</tr>
<tr>
<td>41 – 50</td>
<td>17</td>
<td>(30.91)</td>
</tr>
<tr>
<td>51 – 60</td>
<td>23</td>
<td>(41.82)</td>
</tr>
<tr>
<td>61 – 70</td>
<td>3</td>
<td>(5.45)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>13</td>
<td>(23.64)</td>
</tr>
<tr>
<td>Male</td>
<td>42</td>
<td>(76.36)</td>
</tr>
<tr>
<td>Type of Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry Certification</td>
<td>4</td>
<td>(8.70)</td>
</tr>
<tr>
<td>Associate Degree</td>
<td>9</td>
<td>(19.57)</td>
</tr>
<tr>
<td>Bachelor's Degree</td>
<td>19</td>
<td>(41.30)</td>
</tr>
<tr>
<td>Master's Degree</td>
<td>9</td>
<td>(19.57)</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>(10.87)</td>
</tr>
</tbody>
</table>
Table 4

Descriptive Statistics for the Independent Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Median</th>
<th>Mode</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Employees in Organization</td>
<td>45</td>
<td>1200</td>
<td>5000</td>
<td>10707.93</td>
<td>37319.29</td>
</tr>
<tr>
<td>Number of Employees in IT Support</td>
<td>40</td>
<td>66.50</td>
<td>2600</td>
<td>159.42</td>
<td>279.61</td>
</tr>
<tr>
<td>Number of Employees in VC Support</td>
<td>44</td>
<td>4</td>
<td>1</td>
<td>16.90</td>
<td>50.49</td>
</tr>
<tr>
<td>Number of VC Enabled Rooms</td>
<td>48</td>
<td>32.50</td>
<td>50</td>
<td>401.12</td>
<td>2301.55</td>
</tr>
<tr>
<td>Ratio of # of Number of VC Staffs to # of VC Rooms</td>
<td>40</td>
<td>8.50</td>
<td>2.00</td>
<td>12.88</td>
<td>15.60</td>
</tr>
</tbody>
</table>

Hierarchical Regression Analysis for the Videoconferencing Technical Survey

Research Question 1 was designed to examine what factors affect videoconferencing professionals’ abilities to include collaborative capabilities in videoconferencing room design. To study the relationships between the independent and the dependent variables, a hierarchical multiple linear regression model was used. Based on a priori information on how the predictors work collectively, the hierarchical regression model tested for Research Questions 1A-1C consists of three sequential blocks with variables within each step entered simultaneously.

Before the examination of the regression analysis results, Table 5 presents the descriptive statistics for seven variables related to perceptions of collaboration in videoconferencing rooms, as well as the dependent variable as a composite score of these seven variables. The composite score was created by summing the seven variables related to perceptions of collaboration in videoconferencing room design. If all questions were answered, the lowest score possible would be 7 and the highest would be 35. The average composite score was 28.31%, with a standard deviation of 4.81%. 

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Table 5

*Descriptive Statistics for the Variables Related to Perceptions of Collaboration in Videoconferencing Rooms*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placement of Viewing Monitors</td>
<td>55</td>
<td>3</td>
<td>5</td>
<td>4.69</td>
<td>0.61</td>
</tr>
<tr>
<td>Size of Viewing Monitors</td>
<td>53</td>
<td>3</td>
<td>5</td>
<td>4.74</td>
<td>0.56</td>
</tr>
<tr>
<td>Size of Image on Viewing Monitors</td>
<td>54</td>
<td>3</td>
<td>5</td>
<td>4.70</td>
<td>0.57</td>
</tr>
<tr>
<td>Push To Talk Microphones with PTZ</td>
<td>53</td>
<td>1</td>
<td>5</td>
<td>3.21</td>
<td>1.17</td>
</tr>
<tr>
<td>Wireless Microphones in Larger Rooms</td>
<td>55</td>
<td>1</td>
<td>5</td>
<td>3.84</td>
<td>1.15</td>
</tr>
<tr>
<td>Gaze Angle for Presenter Camera</td>
<td>53</td>
<td>2</td>
<td>5</td>
<td>4.08</td>
<td>0.81</td>
</tr>
<tr>
<td>Ceiling Microphones</td>
<td>54</td>
<td>1</td>
<td>5</td>
<td>3.65</td>
<td>1.08</td>
</tr>
<tr>
<td>Composite*</td>
<td>55</td>
<td>6</td>
<td>35</td>
<td>28.31</td>
<td>4.81</td>
</tr>
</tbody>
</table>

*Note.* Composite scores were calculated as sum of the seven scales, serving as the dependent variable in the regression model.

Table 6 presents the hierarchical regression analysis results with three blocks of variable entry. The first block (Step 1) reflects the ratio of staffing levels to number of supported videoconferencing rooms; the second (Step 2) includes the learning opportunities and experience of videoconferencing professionals; and the third (Step 3) reflects the age of the videoconferencing professionals.
Table 6
Hierarchical Regression Analyses for the Videoconferencing Technical Survey

<table>
<thead>
<tr>
<th>Predictor</th>
<th>ΔR²</th>
<th>B</th>
<th>SE</th>
<th>B</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.032</td>
<td></td>
</tr>
<tr>
<td>Number of Employees in VC Support</td>
<td>.032</td>
<td>-.02</td>
<td>.03</td>
<td>-.10</td>
<td>-.59</td>
</tr>
<tr>
<td>Ratio of # of Employees to # of Rooms</td>
<td></td>
<td>-.04</td>
<td>.05</td>
<td>-.17</td>
<td>-.99</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.423*</td>
<td></td>
</tr>
<tr>
<td>Number of Employees in VC Support</td>
<td></td>
<td>-.03</td>
<td>.03</td>
<td>-.13</td>
<td>-.73</td>
</tr>
<tr>
<td>Ratio of # of Employees to # of Rooms</td>
<td></td>
<td>-.05</td>
<td>.04</td>
<td>-.20</td>
<td>-1.31</td>
</tr>
<tr>
<td>Year Latest VC Room Installed</td>
<td></td>
<td>1.22</td>
<td>.45</td>
<td>.46</td>
<td>2.68*</td>
</tr>
<tr>
<td>Job Training</td>
<td></td>
<td>.48</td>
<td>1.35</td>
<td>.06</td>
<td>.36</td>
</tr>
<tr>
<td>Conferences</td>
<td></td>
<td>-1.35</td>
<td>1.17</td>
<td>-.18</td>
<td>-1.16</td>
</tr>
<tr>
<td>On-site Classes</td>
<td></td>
<td>-.92</td>
<td>1.31</td>
<td>-.11</td>
<td>-.70</td>
</tr>
<tr>
<td>Online Training</td>
<td></td>
<td>3.22</td>
<td>1.29</td>
<td>.44</td>
<td>2.49*</td>
</tr>
<tr>
<td>Last Training/Conference</td>
<td></td>
<td>-.09</td>
<td>.53</td>
<td>-.03</td>
<td>-.17</td>
</tr>
<tr>
<td>Years Worked in Industry</td>
<td></td>
<td>-.16</td>
<td>.10</td>
<td>-.26</td>
<td>-1.57</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.102</td>
<td></td>
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<tr>
<td># of Employees in VC Support</td>
<td></td>
<td>-.01</td>
<td>.03</td>
<td>-.07</td>
<td>-.40</td>
</tr>
<tr>
<td>Ratio of # of Employees to # of Rooms</td>
<td></td>
<td>-.03</td>
<td>.04</td>
<td>-.13</td>
<td>-.85</td>
</tr>
<tr>
<td>Year Latest VC Room Installed</td>
<td></td>
<td>.89</td>
<td>.45</td>
<td>.34</td>
<td>1.99</td>
</tr>
<tr>
<td>Job Training</td>
<td></td>
<td>-.22</td>
<td>1.31</td>
<td>-.03</td>
<td>-.17</td>
</tr>
<tr>
<td>Conferences</td>
<td></td>
<td>-1.18</td>
<td>1.10</td>
<td>-.16</td>
<td>-1.07</td>
</tr>
<tr>
<td>On-site Classes</td>
<td></td>
<td>-.54</td>
<td>1.28</td>
<td>-.07</td>
<td>-.42</td>
</tr>
<tr>
<td>Online Training</td>
<td></td>
<td>3.00</td>
<td>1.21</td>
<td>.41</td>
<td>2.47*</td>
</tr>
<tr>
<td>Last Training/Conference</td>
<td></td>
<td>-.07</td>
<td>.49</td>
<td>-.02</td>
<td>-.13</td>
</tr>
<tr>
<td>Years in Industry</td>
<td></td>
<td>-.07</td>
<td>.11</td>
<td>-.11</td>
<td>-.67</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>-1.29</td>
<td>.58</td>
<td>-.37</td>
<td>-2.22*</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td>1.02</td>
<td>1.26</td>
<td>.12</td>
<td>.81</td>
</tr>
</tbody>
</table>

*p < .05
In Table 6, the two predictors entered in Step 1 (i.e., number of VC support staffs and ratio of number of VC staffs to number of VC rooms) represent study variables for Research Question 1A, which focuses on the effect of the staffing of videoconferencing professionals on the level of collaborative capabilities incorporated into room design. Significant tests of the effects in Step 1 of the regression analysis indicate neither of the two predictors showed the significant relationship with the dependent variable. Based on the signs of the regression coefficients (-.02 and -.04, respectively), both predictors showed negative relationship with the level of collaborative capabilities, although these values were not significant. Thus, these results imply that the staffing in a videoconferencing support unit does not have significant influence on the level of collaborative technical features designed in a videoconferencing room.

Step 2 of the regression analysis in Table 6 represents Research Question 1B intended to determine whether the level of knowledge, provided through learning opportunities, and experience affect the level of collaborative capabilities incorporated into room design. The results indicated that only two predictors, latest year of VC room installation and online training, had significant effects on the collaborative aspects in videoconferencing room design. The level of collaborative aspects of design increased with more recent room installations ($\beta = .462; p = .012$). A one standard deviation increase in the year that a videoconferencing room was installed resulted in a .462 standard deviation increase in collaborative room design aspects. In addition, online learning opportunities also influenced the level of collaborative design ($\beta = .443; p = .019$), controlling for the two variables entered in Step 1 in the regression model.
Step 3 of the regression analysis shown in Table 6 represents Research Question 1C, which reflects the characteristics of age and gender of videoconferencing professionals, controlling for the other variables entered in the two previous steps in the model. There was a significant negative correlation between the age of the respondents ($\beta = -.374; p = .036$) and the level of collaborative room design. As age of respondent increased, the number of collaborative features of the rooms declined. Gender was not a significant factor ($p = .428$).

Regarding Research Question 1, the hierarchical regression analysis was conducted to reveal how the characteristics of videoconferencing professionals relate to the overall quality of collaboration sessions, controlling for background demographic variables. Overall, videoconferencing professionals who have been involved more recently in a videoconferencing room installation will be more likely to include higher level of collaborative design aspects in a videoconferencing room. Those who have utilized recent online trainings in the field also are more likely to increase the collaborative designs of a room. However, the older the respondents, the less likely they will be to include more collaborative designs in a videoconferencing room.

One question was asked to provide more in-depth information on possible outside factors that may influence the level of collaborative capabilities included in videoconferencing room design. Table 7 represents the results on these external factors, over which the videoconferencing professionals will have no control.
Table 7

*Descriptive Statistics for Variables on Constraints in Room Designs*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget Constraints</td>
<td>54</td>
<td>1</td>
<td>5</td>
<td>2.35</td>
<td>.894</td>
</tr>
<tr>
<td>Pre-Existing Room Infrastructure</td>
<td>55</td>
<td>1</td>
<td>5</td>
<td>2.47</td>
<td>.858</td>
</tr>
<tr>
<td>Client Requests</td>
<td>54</td>
<td>1</td>
<td>5</td>
<td>3.02</td>
<td>.961</td>
</tr>
<tr>
<td>Other</td>
<td>49</td>
<td>2</td>
<td>5</td>
<td>3.16</td>
<td>.874</td>
</tr>
</tbody>
</table>

Of the respondents surveyed, budget constraints and pre-existing room infrastructure impacted the final videoconferencing room design either “always” or “frequently” approximately 50% of the time on each variable.

**Results From End-User Survey**

To provide a more holistic view of collaboration in videoconferencing rooms, a concurrent pilot study was conducted with a population of current end-users of videoconferencing. An initial review of the new survey instrument was conducted by content experts. After the review and some modifications of the survey based on the content expert feedback, the survey was administered using the Qualtrics online survey research system. For this pilot study, a convenience sampling of faculty members at a university who have taught via videoconferencing technology in the current academic year was selected.

**Finding Related to Research Question 2**

This section addresses the analysis of Research Question 2: Does improved feeling of closeness increase participants’ perceptions on the quality of collaboration?

For this investigation, the current study explored the following specific questions:
Research Question 2A: Does the audio system in a videoconferencing room affect end-users’ perceptions on the quality of collaboration?

Research Question 2B: How does the level of opportunity for learning about collaborative room aspects affect the overall quality of collaboration sessions?

Research Question 2C: Does gaze angle in videoconferencing rooms impact end-users’ perceptions of the quality of collaboration?

In the End-User Survey, the level of participants’ perceptions on the quality of collaboration in videoconferencing rooms was reflected in a series of 5-point Likert scale items, and the composite score of the participants’ responses to these items served as the dependent variable. The four research-based components include (a) level of satisfaction with communication levels between faculty and students in a videoconferencing class, (b) level of satisfaction with how clearly participants can understand meanings in a videoconferencing class, (c) level of satisfaction with the feeling of closeness between faculty and students, and (d) level of satisfaction with how well all sites can work together.

Demographics Information of Participants for the End-User Survey

End-users who completed the pilot survey are all faculty members at the same university and have all taught a distance learning course via videoconferencing technology in the current academic year. They represent seven colleges within the university and a variety of courses and disciplines. Table 7 presents frequency information for the demographic variables, including experience with teaching a distance learning course via videoconferencing and years of experience teaching. Twenty-five percent reported having 6 to 10 years of teaching experience in a postsecondary
educational setting, with 13.9% reporting both 11 to 15 and 16 to 20 years of experience. Nearly 20% of the respondents reported having more than 21 years of experience at the postsecondary level. Most of the respondents were between the ages of 51 – 60 (36.1%), with 27.8% between 45 – 50, 16.7% between 31 – 40, and 13.9% between 61 – 70 years of age. Fifty-eight percent were female and 38.9% were male. It should also be noted that the faculty teach in several different videoconferencing classrooms all containing the same functionality and very similar control systems. However, the classroom design and configurations vary by room.

Before the examination of the correlation analysis results, Table 8 presents the descriptive statistics for six variables related to perceptions of closeness in videoconferencing classes, as well as the dependent variable as a composite score of these six variables. Composite scores were created for the three specific research areas, and the overall composite score was then created by summing all six variables related to perceptions of closeness in videoconferencing classes. If all questions were answered, the lowest score possible would be 6 and the highest would be 30. The average composite score was 10.20%, with a standard deviation of 4.00%. 
### Table 8

*Demographics Information on College, Years Teaching, Gender, and Age Range*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>College</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education and Behavioral Sciences</td>
<td>12</td>
<td>(33.33)</td>
</tr>
<tr>
<td>Health and Human Services</td>
<td>6</td>
<td>(16.7)</td>
</tr>
<tr>
<td>Business</td>
<td>3</td>
<td>(8.3)</td>
</tr>
<tr>
<td>Science and Engineering</td>
<td>4</td>
<td>(11.1)</td>
</tr>
<tr>
<td>Potter</td>
<td>8</td>
<td>(22.2)</td>
</tr>
<tr>
<td>University College</td>
<td>1</td>
<td>(2.8)</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>(2.8)</td>
</tr>
<tr>
<td><strong>Years Teaching in Postsecondary Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – 5</td>
<td>6</td>
<td>(16.7)</td>
</tr>
<tr>
<td>6 – 10</td>
<td>9</td>
<td>(25.0)</td>
</tr>
<tr>
<td>11 – 15</td>
<td>5</td>
<td>(13.9)</td>
</tr>
<tr>
<td>16 – 20</td>
<td>5</td>
<td>(13.9)</td>
</tr>
<tr>
<td>21+</td>
<td>7</td>
<td>(19.4)</td>
</tr>
<tr>
<td><strong>Distance Learning Courses Taught Via Videoconferencing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – 3</td>
<td>12</td>
<td>(33.3)</td>
</tr>
<tr>
<td>4 – 6</td>
<td>7</td>
<td>(19.4)</td>
</tr>
<tr>
<td>7 – 10</td>
<td>5</td>
<td>(13.9)</td>
</tr>
<tr>
<td>11 – 15</td>
<td>3</td>
<td>(8.3)</td>
</tr>
<tr>
<td>15+</td>
<td>6</td>
<td>(16.7)</td>
</tr>
<tr>
<td><strong>Age Range</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31 – 40</td>
<td>6</td>
<td>(16.7)</td>
</tr>
<tr>
<td>45 – 50</td>
<td>10</td>
<td>(27.8)</td>
</tr>
<tr>
<td>51 – 60</td>
<td>13</td>
<td>(36.1)</td>
</tr>
<tr>
<td>61 – 70</td>
<td>5</td>
<td>(13.9)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>21</td>
<td>(58.3)</td>
</tr>
<tr>
<td>Male</td>
<td>14</td>
<td>(38.9)</td>
</tr>
</tbody>
</table>
Table 9

*Descriptive Statistics for Independent Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Remote Viewing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display Placement</td>
<td>35</td>
<td>1</td>
<td>4</td>
<td>2.49</td>
<td>1.12</td>
</tr>
<tr>
<td>Display Size</td>
<td>35</td>
<td>1</td>
<td>4</td>
<td>2.54</td>
<td>1.06</td>
</tr>
<tr>
<td>Image Size on Display</td>
<td>35</td>
<td>1</td>
<td>5</td>
<td>2.60</td>
<td>1.14</td>
</tr>
<tr>
<td>Composite – Remote Viewing</td>
<td>35</td>
<td>3</td>
<td>12</td>
<td>7.62</td>
<td>2.78</td>
</tr>
<tr>
<td><strong>Gaze Angle for Presenter Camera</strong></td>
<td>55</td>
<td>1</td>
<td>5</td>
<td>3.84</td>
<td>1.15</td>
</tr>
<tr>
<td><strong>Audio System</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructor Microphone</td>
<td>35</td>
<td>1</td>
<td>5</td>
<td>1.89</td>
<td>.867</td>
</tr>
<tr>
<td>Student Microphone</td>
<td>35</td>
<td>1</td>
<td>5</td>
<td>2.31</td>
<td>1.38</td>
</tr>
<tr>
<td>Composite – Audio System</td>
<td>35</td>
<td>2</td>
<td>7</td>
<td>4.20</td>
<td>1.56</td>
</tr>
<tr>
<td><strong>Overall Composite</strong>*</td>
<td>35</td>
<td>4</td>
<td>20</td>
<td>10.20</td>
<td>4.00</td>
</tr>
</tbody>
</table>

*Note.* Composite scores were calculated as sum of the six scales, serving as the dependent variable in the regression model.

**Correlational Analysis for the Videoconferencing End-User Survey**

Research Question 2 was designed to examine what factors impact participants’ feelings and perceptions of closeness in videoconferencing environments. To study the relationships between the independent variables and the dependent variables, a correlational analysis was used.
Table 10

*Correlational Analysis for the Videoconferencing End-User Survey (N=35)*

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Perceptions on Closeness</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Remote View</td>
<td>.650**</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Audio System</td>
<td>.349*</td>
<td>.280</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4. Gaze Angle</td>
<td>.311</td>
<td>.527**</td>
<td>-.010</td>
<td>-</td>
</tr>
</tbody>
</table>

**p < .01; *p < .05

**Research Question 2A:** Does the view of remote participants impact end-users perceptions on the quality of collaboration?

Three survey items reflected Research Question 2A and asked about respondents’ opinions on the placement and the size of the viewing display, and the size of the image on the viewing display in the classrooms in which they primarily teach. There was a significant correlation \( r = .650; p < .01 \) found between the faculty’s perceptions on closeness and the composite of the items relating to remote viewing.

**Research Question 2B:** Does the audio system affect end-users’ perceptions on the quality of collaboration?

Two survey items reflected Research Question 2B and asked about respondents’ opinions on the student and faculty microphones. There was a significant correlation \( r = .349; p < .05 \) found between the faculty’s perceptions on closeness and the composite of the items relating to the audio system.

**Research Question 2C:** Does gaze angle in videoconferencing rooms impact end-users’ perceptions of the quality of collaboration?
One survey item reflected Research Question 2C and asked about respondents’ opinions on the placement of the instructor or presenter camera. There was no significant correlation (r = -.311) found between the faculty’s perceptions on closeness and this question.

**Comparison of Videoconferencing Professionals and End-User Perceptions**

Research Question 3 was designed to examine whether there were differences in the perceptions between the videoconferencing professionals and end-users on how often important collaborative room characteristics are incorporated into the videoconferencing room designs.

**Results from Independent Samples t-tests**

For Research Question 3, an independent samples t-test was conducted to compare videoconferencing professionals’ perceptions and end-users’ perceptions on the implementation levels of the three key components of technical collaborative designs. A comparison of the means on questions regarding perceptions on viewing of the remote participants, the audio system, and gaze angle revealed a significant difference between the two groups on all five of the items. Videoconferencing professionals rated the items much higher on the collaborative implementations than the end-users.
Table 11

**Independent Samples t-test Between Groups**

<table>
<thead>
<tr>
<th>Videoconferencing Component</th>
<th>VC Technical</th>
<th>End-User</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Placement of Display</td>
<td>55</td>
<td>4.69</td>
<td>.605</td>
</tr>
<tr>
<td>Size of View</td>
<td>54</td>
<td>4.74</td>
<td>.560</td>
</tr>
<tr>
<td>Image Size</td>
<td>53</td>
<td>3.21</td>
<td>.571</td>
</tr>
<tr>
<td>Audio System</td>
<td>53</td>
<td>3.21</td>
<td>1.16</td>
</tr>
<tr>
<td>Gaze Angle</td>
<td>53</td>
<td>4.08</td>
<td>.805</td>
</tr>
</tbody>
</table>

*p < .05

**Findings from Interview Data and Open-Ended Survey Question**

**Interviews with Videoconferencing Professionals**

To fully examine technical design of videoconferencing rooms, methodological triangulation was used (Patton, 2002). Methodological triangulation uses mixed-methods of data collection, in this case, quantitative data from a survey and qualitative data from interviews. Of the 56 respondents who completed the technical survey, six self-selected to participate in the interview process and notified the principal investigator of their willingness to be interviewed. These semi-structured interviews were completed with respondents being asked standard open-ended questions to begin the interviews and then moving to a more “informal conversational interview” (Patton, 2002, p. 342) to supply better detailed perspectives on how videoconferencing rooms are designed in a variety of fields, with a variety of support levels. The interviewees work in healthcare, education, business, and consulting and were geographically in five different states. Because the
respondents represent a variety of industries that typically utilize videoconferencing and represent a variety of specialist support roles within videoconferencing, they allow for a richer collection of information and deeper insight into videoconferencing room design (Patton, 2002). One additional interview was conducted with a nationally recognized authority on videoconferencing room design and collaboration.

**Opportunities for Learning**

Of the individuals interviewed, three of the six mentioned recent attendance at a conference as beneficial to learning about new technologies and functionality. However, two stated that had little to no formal training on either the technology or best-practices in collaborative room design. One individual stated that even issues as important as gaze angle were not discussed in the technical training. It was “very much technical training, set up, and configuration but not necessarily design” as he stated. One individual stated that he learned almost through “osmosis” as he worked with room installations, rather than having attended any structured trainings, although he also mentioned regularly attending industry-specific conferences.

Four of the individuals mentioned having recently installed new videoconferencing rooms and/or were in the process of having new rooms installed. One individual stated that technicians can “talk to integrators to get all kinds of ideas,” and the “best ideas come from ones who have done this and use it every day.”

One interview from the technical side provided unique insight into the end-user perspective in the telehealth field from an individual who provides technical support for medical providers using videoconferencing for telehealth applications. This interview demonstrates how the design of the videoconferencing environment impacts the
collaborations. This videoconferencing setting, which typically uses mobile carts, appears to provide the camera angle, remote site view, and audio to provide the most optimal collaborative environment, allowing participants to focus on the interaction, not the technology. The camera is directly on the patient and another is directly on the medical provider. Because of this one-on-one design, the medical providers have become very comfortable with the environment and do not have issues with the technology. This end-user stated that, “adult patients may be skeptical at first, but that doesn't last long.” The comfort level of the doctor appears to help put the patient at ease with the technology as well. Similarly, another technologist specialist discussed how conference rooms with videoconferencing are perceived much better than classrooms equipped with videoconferencing. The satisfaction levels in this setting suggest the collaboration that can be accomplished when the design and placement of the equipment is well planned.

**Interview with Nationally-Recognized Industry Expert**

One individual interviewed is a nationally recognized leader on the topic of human-factors in videoconferencing. He has studied what he calls “the art of videoconferencing” and stated that the “senses provide the feeling of being in that room – the “illusion.” Participants do not need to see the technology. The videoconferencing professionals need to “think about the user, not the technology,” which was a continuing theme throughout this study. This industry expert even stated that videoconferencing professionals should not view themselves as a “technologist, but a psychologist” to focus more on how the collaboration occurs within the room. Videoconferencing rooms should be viewed as “collaborative learning, not tele-learning.”
Unfortunately, in his view, most deployments of videoconferencing systems fail because they are simply not used. He gave the example that companies deploy a new room, they send out a bulletin announcing the new room, people come in to look at it, but they see the key pad and do not think they can use it. “Individuals who are higher up don't want to look like fools.” One key example of how room design helps to improve the user experience is the implementation of new control systems that remove the remote controllers from the rooms. Intuitive touch screens are now being installed in rooms, which has “helped a lot.”

Companies do not deploy well and do not provide the proper training; and then users are not supported properly, all of which lead companies to develop a cultural view that videoconferencing does not work. One common mistake in design and implementation is to “position the camera at the front of the room and set it with a wide zoom” to see the room. However, the advantage of videoconferencing is its ability to allow people to see the nonverbal communications that occur within a collaborative setting. Still, if the technologists do not “frame people properly,” it becomes useless. This is “one thing we need to fix.” Again, this is a design element that can be incorporated into the videoconferencing room environment to improve the collaborative experience. Historically, he believes, the attention has always been on the technology. It is not simply putting furniture, a camera, and a microphone in a room that creates a collaborative environment. The environments need to create that sense of presence, and as he says, “presence about how the mind perceives the reality, not the reality itself.” The perception that individuals are in the same room provides the collaborative experience. Technologists have to know how the “users are using the room” to provide
this stronger perception. Gaze angle’s influence on closeness from the remote participant’s view would be an item for future studies. As this interviewee stated, “We have improved the technology enough so that we can see the eyes, so we must be sure they are sending the right message to the far end.”

**Interviews with End-Users (Faculty)**

Of the 36 respondents who completed the pilot survey, 5 self-selected to participate in an additional study on the subject matter and notified the principal investigator of their willingness to be interviewed. These interviews also were completed in a semi-structured format to supply richer, more detailed perspectives on perceptions of collaboration in videoconferencing rooms (Patton, 2002). The interviews were conducted with participants who were a subset of the End-User Survey population. The final question on the end-user survey also was open-ended to allow for anonymous comments on the overall collaborative capabilities of the environments.

**Viewing of Remote Participants**

The ability to view the students was a critical issue in interviews. One professor stated, “If I can't comment on what they are wearing, then I can't feel close.” Concern over placement of the viewing monitors was mentioned by all five faculty members during interviews. One advised that they “have to put one group out of focus to see others.” Another advised that the ability to see the remote students was hindered in longer rooms and she had started “limiting each location to only 15 students.” She stated that, by controlling class size, this also helped to manage the students at the distance sites and helped “to build relationships across sites...” because with fewer students they would sit closer to the front of the room and she could see better them. “Departments really need to be proactive if they are thinking about doing this – What is the optimal learning
environment?” Responses varied across disciplines. Several professors commented that the type of class being taught would affect whether the room provided a collaborative environment. One professor also advised that he felt “closer to them than they do to me,” referring to the students at the remote sites. One professor made several remarks on the varying levels of satisfaction with various room designs around the university. She commented on one occasion, in a more favorable classroom, that they could see a student from a remote site clearly enough to realize they were confused about the topic being discussed. “Literally, I could see it on the monitor.” One faculty also stated, “The connectedness across campuses depends on the teacher effort as much or more than the cameras and camera views.”

**Audio Systems**

Interviews with faculty members indicated the audio system overall is critical to creating or hindering a collaborative environment. One faculty member, who typically teaches in a standard videoconferencing room, had a smaller class one semester and utilized a room with the open microphone system. She stated, “I felt like the interaction was so much better. Not having to wait on delay, having camera zoom...” She continued with, “We can all just talk, no interruption of conversation,” which she believed “really affects being able to build that sense of communication in the classroom.” Another professor advised he would prefer a room with “one big mic” and that, currently, it is hard to be “close.” Several comments were made regarding the audio systems in the classrooms. Some comments were related to the microphone systems for the faculty, and some mentioned issues with the desktop microphones of the students. Having ceiling microphones that are always on was a desire of several faculty. While this would allow
for all background and general conversations to be heard, this is viewed as a positive. One faculty member stated, “I can control more of what is going on in the classroom when there is so much that is out of control.” Another faculty member also commented on the current closed microphones and stated, “It is difficult not to be able to hear the other room. I wonder if some students take advantage of that.” Mirroring the comments in the interviews conducted, one survey comment was, “Live/seminar mikes would be nice. Distant site students look small in a large IVS room because the monitor is so far away.” Several faculty commented that the current push-to-talk microphones appear to slow the flow of conversation with the comment being made, “The audio delay still reduces the flow of class discussions. Need real live time.”

**Comments on Collaboration**

While the videoconferencing classrooms are reported to work well with lecture-style courses, some faculty typically utilize group work in their classes. Several comments were made regarding the inability to do effective group work among the sites during videoconferencing classes. One professor in an interview even stated that “rows are not conducive to group work. We need groups, not rows.” Another commented, “I would like the tables organized where they are movable,” which was similar to other comments reflecting the need for flexibility or mobility of the furniture in these rooms, benefitting group work at the sites. Another related comment was, “My students work in groups and I cannot hear the conversations of the distance learners. How can we improve in this area?”

More general comments also were received on the overall videoconferencing environment ranging from, “I think this is a great service and I am comfortable teaching
an ITV class” to “There is no substitute for ‘being there’; however, some small fixes allowing for greater instructor and student mobility would enhance student-centered learning.”

**Summary**

In this chapter, the results of the videoconferencing technical survey and the videoconferencing end-user survey were presented. Comments and quotations were presented from a series of interviews from both perspectives: the technical side of design and the end-user perspective on collaboration. The significant results were presented from both studies, as well as the results of a comparison study between the technical views and end-user views on specific areas of videoconferencing room design. This comparison indicated a significant difference between the technology specialists’ opinions and the end-users’ perceptions on the level of collaborative aspects included in room design.
CHAPTER V: DISCUSSION

This study examined the characteristics of videoconferencing professionals’ influence on the level of collaborative capabilities incorporated into videoconferencing rooms. Concurrently, a pilot study was conducted of videoconferencing end-users, in this case a convenience sampling of faculty at a university, to gauge the value of three specific collaborative room characteristics defined as (1) views provided of remote participants, (2) the impact of audio systems on collaboration, and (3) the impact of gaze angle of the presenter on the collaboration. Last, a comparison analysis was conducted to compare videoconferencing professionals’ perceptions versus end-users’ perceptions on the implementation levels of the three key components of technical collaborative design.

Problem

Videoconferencing technologies are complex because they consist of two completely separate areas of function. A videoconferencing session may work technically well with audio and video connections provided for participants, but they still may fail to provide the collaborative environment participants need. Both components have to come together for a fully successful videoconferencing session. This is often referred to in terms of technical or services side and the human-factor or meeting side.

Purpose

Previous research on videoconferencing technologies focused on the value of providing face-to-face communications through technology; however, participant satisfaction on videoconferencing has varied. Studies on the effectiveness of communications within videoconferencing environments often investigated how videoconferencing provides a collaborative environment; but did not examine the
technical room designs that directly affect this collaboration (Carville & Mitchell, 2000; Currie 2007; Seay, Rudolph, & Chamberlain, 2001; Silverstein & Lineberry, 2002).

Most videoconferencing room implementations are guided by the information technology (IT) areas, with end-users traditionally having little say in these implementations. Prior research indicates that many end-users feel a disconnect between IT personnel’s understanding of how they use the collaborative technologies (Kettinger & Lee, 2002). Complicating the issue is the fact that the term “videoconferencing room” can refer to a wide array of audio and video equipment designs and installations. Few studies, to the researcher’s knowledge, have been conducted on videoconferencing technical room designs and their impact on the collaboration capabilities within the rooms. With the increasing videoconferencing usage, research is needed on how to design collaborative rooms to better ensure participants’ needs are met and satisfaction levels are improved.

Therefore, this study was conducted to seek to fill this void on collaborative synchronous technology implementations. A review of existing literature was provided on relevant areas including technology implementation; theories addressing computer-mediated communications, including transactional distance and networking perspectives; and theories guiding change management. This last chapter will discuss the findings of the study and provide an analysis of the quantitative and qualitative data collected. This chapter also will consider how the findings can be applied to newer conferencing technologies and recommend areas for future research.
Procedures

The following research questions guided this study:

**Research Question 1:** How do the characteristics of videoconferencing professionals relate to the overall quality of collaboration sessions, controlling for background demographic variables?

  Research Question 1A: Does the level of staffing of videoconferencing professionals units affect the level of collaborative capabilities incorporated into room design?

  Research Question 1B: Does the level of knowledge, provided through learning opportunities and experience, affect the level of collaborative capabilities incorporated into room design?

  Research Question 1C: To what extent are the characteristics of videoconferencing professionals related to the level of collaborative capabilities incorporated into room design?

**Research Question 2:** Does improved feeling of closeness increase participants’ perceptions on the quality of collaboration?

  Research Question 2A: Does the view of remote participants increase participants’ feelings of collaboration?

  Research Question 2B: Does the audio system affect participants’ feelings of collaboration?

  Research Question 2C: Does gaze angle in videoconferencing rooms impact participants’ feelings of collaboration?
Research Question 3: Are there differences in the perceptions between the videoconferencing professionals and end-users on how often important collaborative room characteristics are incorporated into the videoconferencing room designs?

This study examined the relationship between videoconferencing room design and perceptions on the levels of collaboration in a videoconference. The research design included two separate surveys focusing on the two primary research questions. One survey was administered to videoconferencing professionals, and one was administered to end-users of videoconferencing. For the end-users survey, faculty members from one university who had taught via videoconferencing technologies in the current academic year were selected to serve as the pilot group for this survey. Both surveys were reviewed by content experts and modified, as needed, before the actual administration.

For the technical survey, research questions focused on how the level of videoconferencing support staff, their level of knowledge and learning opportunities on videoconferencing room design, and general characteristics affected the implementation of collaborative room characteristics. A survey was developed to provide quantitative data on the question, while interviews were conducted to provide qualitative information to supplement the quantitative study.

Concurrently, this study examined how these technical aspects in videoconferencing room design impact the end-users’ perceptions on the quality of collaboration within videoconferencing rooms using empirical data drawn from the pilot survey. The survey examined perceptions on how images of the remote participants are seen, perceptions on the audio systems, and perceptions on gaze angle. Interviews also were conducted to supplement the quantitative data as well. Last, the study compared
how often specific room characteristics, as reported by end-users, are incorporated into
the videoconferencing room design, as reported by the videoconferencing professionals.

Findings

Research Question 1A asked whether the characteristics of videoconferencing professionals’ impacts the level of collaborative capabilities incorporated in videoconferencing room designs. These results imply that the staffing in a videoconferencing support unit does not have significant influence on the level of collaborative technical features designed in a videoconferencing room.

Research Question 1B examined whether the level of knowledge, provided through learning opportunities and experience, affect the level of collaborative capabilities incorporated into room design. The results indicate that only two predictors had significant effects on the collaborative aspects in videoconferencing room design. The significant predictors were (a) the latest year of a videoconferencing room installation and (b) recent online training.

Research Question 1C examined the extent, if any, that characteristics of videoconferencing professionals were related to the level of collaborative capabilities incorporated into room design. A significant negative correlation was noted between the age of the respondents and the level of collaborative room design. As age of respondent increased, the number of collaborative features of the rooms declined. Gender was not a significant factor.

Overall, significant findings for Research Question 1 found that videoconferencing professionals who have been involved more recently in a videoconferencing room installation will be more likely to include a higher level of
collaborative design aspects as those who have utilized recent online trainings. However, the older the respondents, the less likely they will be to include more collaborative designs in a videoconferencing room. While the survey analysis did not show many areas with significant impact on the level of collaborative room designs, this is anticipated. Videoconferencing professionals, in interviews, reported most training courses are technology-focused and do not incorporate collaborative theories. Comparison of the survey results and interviews indicate that more recent experience in room installations will give videoconferencing professionals more current collaborative room ideas and designs gained from working with vendors and consultants who are more likely to have knowledge on the newest technologies and functionality.

Research Question 2 examined whether feelings of closeness in videoconferencing environments increase the participants’ perceptions on the quality of the collaboration. To study the relationships between the independent and the dependent variables, a correlational analysis was used.

Research Question 2A examined whether the view of remote participants increase participants’ feelings of collaboration. Respondents’ opinions were provided on the placement of the viewing display, the size of the viewing display, and the size of the image on the viewing display in the classrooms in which they primarily teach. There was a significant correlation in the survey analysis between the faculty’s perceptions on closeness and the composite of the items relating to remote viewing. The placement and size of the viewing displays and the size of the image on the display, which can all vary greatly, should work together to provide a clear view of the remote participants. Interviews also indicated this was important to the faculty. Providing the technology for
participants to see the remote participants clearly enough to view nonverbal aspects of communication has been shown to improve the collaboration between the sites and decrease the perception of transactional distance. Interviews with participants supported this finding as well. It is not enough to have a camera in the room that provides only a view of the room, when the participants need to actually have a good view of the people in the remote location. One complaint voiced in videoconferencing settings is end-users who feel they cannot connect well with remote participants because they see the images only as small squares on a screen, which is often called the “Hollywood Squares” screen layout. While most videoconferencing systems allow for changes in the screen layout, if the end-users and the technical support staff do not work together, the screen layout selected may not meet the needs of the participants. This type of complaint suggests the apparent disconnect between the technology support and the end-users (Kettinger & Lee, 2002).

Research Question 2B examined whether the audio systems affect participants’ feelings of collaboration. Survey items asked about respondents’ opinions on the microphones, with a significant correlation found between the faculty’s perceptions on closeness and the composite of the items relating to the audio system. This finding was supported with conducted interviews, as faculty stated that audio systems perceived to hinder free-flowing communications were viewed negatively. Having ceiling microphones that are always on was cited in several faculty interviews as a design feature that would work well. Faculty stated that, not only would conversations become more natural, they also could provide more control over the remote classrooms. Without open
microphones in the classrooms, students can conduct sidebar conversations that may be distracting to other students and not beneficial to class discussion.

Research Question 2C examined whether gaze angle in videoconferencing rooms impacted participants’ feelings of collaboration. Respondents’ opinions were requested on the placement of the instructor or presenter camera, and no significant correlation was found between the faculty’s perceptions on closeness and this question. Technically, the camera image should be centered as closely as possible with participants’ eye level. Any difference between this is considered gaze angle, as in cameras that are offset to either side or set above or below participant eye level. When individuals look, or appear to look, straight into the camera, then the remote participants will have the perception they are being directly observed. While it is important, gaze angle is not as readily observed by the local participant, which could explain why this was not significant. This question might be better asked of participants at a remote location. However, gaze angle still should still be considered an important part of the collaborative room design, since the literature indicates that the view of the person speaking can affect one’s level of influence in the communication (Huang et al., 2012) and gaze angle’s importance in the success or failure of a meeting (Badler et al., 2002; Gemmell et al., 2000; Huang et al., 2012; Macrae et al., 2002).

Overall, Research Question 2 indicates that feelings of closeness in videoconferencing environments do increase the participants’ perceptions on the quality of the collaboration. Well-designed videoconferencing rooms can provide the collaboration needed by participants, which can improve participants’ perceptions of the technology. Thought must be given to where the camera is located, how intuitive it is for
the speaker to look into the camera at the correct angle, and the type of view provided by the camera for remote participants. Concurrently, the type of audio system selected should ultimately reflect the end-users' needs to provide the best audio experience for all participants.

As one faculty member stated, there is no substitute for "being there, however, some small fixes allowing for greater instructor and student mobility would enhance student-centered learning.” This comment is further indicative that design and implementation can make a difference in the collaborative setting.

Research Question 3 compared end-users’ views with the videoconferencing professionals’ views on how often important collaborative room characteristics are incorporated into the videoconferencing room designs. A series of questions were asked of both the videoconferencing professionals and the end-users, which compared their perceptions on the level of collaborative technologies implemented in videoconferencing rooms. A comparison of the means on these five matched questions reveals a significant difference between the groups on all five of the items. Videoconferencing professionals consistently rated the collaborative items as being incorporated at a higher level than rated by the end-users. This finding is supported by previous results that also have indicated a separation between IT and end-users (Kettinger & Lee, 2002) and significant lower levels of end-user satisfaction with videoconferencing in general (Coventry, 1994). With end-users perceiving that collaborative capabilities are not implemented at levels needed to provide quality collaboration between the participants at the levels they actually desire, this is an issue that must be addressed if the collaboration is to be improved. However, while it should be noted that it is difficult for videoconferencing
professionals to gauge the collaboration levels because no standard definition exists for what constitutes a success or failure of a virtual meeting, only about half of videoconferencing providers even measure this type of success at all (Wainhouse, 2010). If the value in videoconferencing is its ability to provide a collaborative environment where participants can see each other well enough to recognize non-verbal communications, then actual room designs must make this possible. The visual aspect of the conferencing should provide an environment that decreases the transactional distance between participants and allows for greater structure and dialogue. Without those capabilities, the value of the technology is reduced.

However, the study also shows that videoconferencing professionals do not always have control over the ability to implement the best technologies in the best designed ways. Of the videoconferencing professionals who responded to the survey, budget constraints and pre-existing room infrastructure were often found to prohibit their abilities to fully incorporate well-designed collaborative capabilities into the rooms. While it may be challenging to measure the success of a videoconferencing session from the technical standpoint, it is an issue that must be addressed. The study clearly shows that technical room design impacts the collaborative capabilities of the rooms, which, in turn, impacts the perceptions of closeness between the participants. Videoconferencing professionals must focus on the user, which is a change in paradigm from the strictly technical views currently prevalent in the industry. Videoconferencing professionals should not view the rooms as videoconferencing rooms, but as collaborative meeting environments. If the collaboration levels are not fully realized, then the user satisfaction will continue to be low. As the only faculty member indicated, the quality of the
technology has improved greatly over the past five years, but the satisfaction levels continue to remain low. Until these collaborative meeting environments genuinely provide the levels of collaboration they have promised, usage will remain below anticipated projections. Some of the collaborative technical designs found to be most significant can be integrated into existing rooms with minor re-configurations. All can be integrated into new room designs, with some of the technologies actually reducing room costs. For example, ceiling microphones, which are often preferred since they provide for a more open conversational flow, may be more cost-effective than if microphones were installed on desks around the room.

**Future Implications**

This study provides a basis on the required technical design elements vital to the creation of an optimal collaborative videoconferencing environment. This foundation of knowledge should be used as a guide to begin conversations on collaboration in videoconferencing and to move, as an industry, to improve participant satisfaction with the technology. Furthermore, the findings also can be utilized to guide implementations of newer varieties of videoconferencing. Continuing changes in technology have improved our abilities to communicate synchronously with full, real-time audio and video from desktop-based systems, as well as mobile videoconferencing solutions. Videoconferencing no longer has to be tied to room-based systems, with participants having to go to specific locations to utilize the technology. End-users can utilize these collaborative tools from the convenience of their own computer, laptop, smartphone, or tablet to virtually communicate and collaborate with colleagues providing regional, national, and international reach. The usage of cloud-based systems, such as Skype,
which are available at little to no cost, continue to see increases in usage. Proprietary systems for desktop videoconferencing such as GoToMeeting, WebEx, and Connect Pro, are becoming increasingly popular, even with the associated costs. In a report issued in December 2009 by the Gartner organization (Mason, 2009), an industry leader in technology research, they predicted more than 200 million employees will have access to desktop-video conferencing by 2015 (Forbes, 2010). The significant increase in mobile device usage and the number of endpoints to be supported are predicted to continue to grow as employees typically now carry multiple mobile devices capable of mobile videoconferencing. It is estimated that, by the end of this year, the number of “mobile-connected devices will exceed the number of people on earth” (Cisco, 2012).

While some issues with room-based videoconferencing systems are eliminated when the conferencing set-up moves to desktop or mobile devices, other issues are magnified. It is far easier to have problems with gaze angle when individuals are relying on a web camera placed on top of the computer monitor or on a hand-held smartphone. While videoconferencing room designs can take into account background images and have highly-controlled locations, end-users will need to be cognitive of these aspects when participating in collaborative sessions from mobile devices. This research can serve as a resource for training opportunities for participants of videoconferencing and will help to improve participant satisfaction with the technology.

**Recommendations for Practice**

With all of the discussion and thought required to provide quality audio and video connections for videoconferencing, it is vital to maintain sight of why these technology solutions are being implemented. The emphasis on videoconferencing room designs
must change from a technology-centric view to a collaborative-centric view. Videoconferencing rooms are not about the technology, but are about the communication and collaboration between geographically distant participants facilitated by the technology. Communication is the primary goal, and the focus of videoconferencing professionals must change to incorporate more of the end-users’ requirements. Implementations of audio and video equipment that technically work well may not always be conducive to optimal collaboration. The usage and needs of participants for a room should be the guide for all installations and implementations.

Research demonstrates how technical advancements have improved the audio and video capabilities utilized in conferences, yet the research also shows how user implementation has lagged behind the projected adoption, in part because user satisfaction with the technology is inconsistent. More collaborative videoconferencing room designs can be achieved if there are increased learning opportunities for videoconferencing professionals in areas of collaborative theories and perspectives, as well as guidance on increasing communication with their end-users. Business and industry should understand that a shift in the focus can benefit the collaboration. A report by Frost and Sullivan (2012) indicated that businesses that utilized advanced collaboration tools were up to five years ahead of their competitors. Decisions can be made more quickly and customer relations can be improved.

Videoconferencing is a two-edged sword, in that it can provide for increased communication opportunities, if implemented appropriately, but it also can add additional challenges. Applications where videoconferencing technology is utilized for distance learning programs should be particularly aware of the need to create the best setting to
meet the educational needs of faculty and students. Without universities incorporating a full pedagogical understanding of implementing an effective classroom learning environment through videoconferencing technologies, the results may not be perceived well by the faculty or students. Distance students who are dissatisfied with the learning experience may not be retained, which is an important issue for universities. However, while the study clearly shows how room design has an impact on the collaboration, the human factor still remains. As one faculty member stated, “The connectedness across campuses depends on the teacher effort as much or more than the cameras and camera views.”

Development of Videoconferencing Room Design Guidelines

Videoconferencing rooms do not have clearly defined definitions of what equipment is included or where it is installed. There is no clear naming convention among videoconferencing professionals or end-users. However, this research has indicated specific aspects of videoconferencing room design that can influence collaboration and end-user satisfaction with the technology. By providing a set of guidelines based upon the research, support professionals can affect videoconferencing room designs to improve end-user satisfaction in future videoconferencing usage.

Guidelines for Best-Practices in Creating Collaborative Videoconferencing Environments

A) Ensure Quality Views of Remote Participants

This should be defined as providing displays that provide a large enough image for the size of the room to ensure local participants can fully see nonverbal expressions of remote participants. This includes reviewing the
placement of the display, the size of the display, and the size of the image on the display. Deeper rooms may need to have larger display devices for the remote view or have the remote view mounted closer to the presenter.

B) Ensure Quality Views of Local Participants
The room camera should be installed to provide a view close enough to ensure remote participants can fully see nonverbal expressions of the local participants. This includes reviewing the gaze angle of the camera and its capability to send a close image out of participants. Camera placement should not provide views of participants where they appear to be in a higher or lower position.

C) Ensure Audio System Meets Participant Needs
How participants will be using the room will closely determine the type of audio system installation. This includes reviewing with the participants whether they need open microphone systems or push-to-talk microphones systems.

D) Develop Room Designs Based on Participant Needs
Videoconferencing professionals should have a written outline of primary usage of the videoconferencing room, developed with communication from the primary participants of the room, to serve as the overarching guide for the room design.

**Limitations of Study**

While the pilot study of end-users’ perceptions on closeness on the quality of collaboration was conducted with a small group of faculty from one university, they were
representative of a variety of teaching disciplines and styles. This preliminary data were very informative; however, a larger study could provide greater data for analysis. Additionally, end-users, in this case the faculty teaching via videoconferencing technology, were asked about the perceptions of gaze angle in the rooms, and no significance was found. However, research indicates gaze angle has a direct impact on how participants are perceived by the remote viewers. Since the faculty may not be aware of how they are being viewed, this question would be better suited to be asked of remote participants in a videoconference than of the participant from the broadcast location.

**Recommendations for Future Studies**

This study focused on collaboration in interactive video rooms from the technical perspective, with a pilot study examining feelings of closeness as perceived from the presenter’s point of view. Future research should include an in-depth review of participant satisfaction with the collaborative aspects of videoconferencing rooms, as correlated with the room design, from the remote participants’ views. Where videoconferencing technologies are utilized to provide distance learning capabilities, with a faculty member presenting from one site and conferencing with one or more remote locations, participant satisfaction should be measured from both the faculty perspective and the student perspective.

With 75% of the respondents indicating they were male, and the interviews indicating primarily male staff, the findings reveal that videoconferencing is an industry primarily consisting of males. This might be an interesting topic for future study.
Summary

This research clearly indicates that videoconferencing professionals have the abilities to design fully collaborative videoconferencing environments. However, the focus has to shift from the technology to the actual collaboration that occurs in these environments.

As several videoconferencing professionals stated, conferencing applications in smaller rooms, such as a corporate conference room or a telehealth setting, are often viewed more favorably than conferencing applications in larger rooms. This may indicate that the primary issues stated with the technology by end-users are more easily addressed in a smaller setting. Sense of closeness, which can decrease the transactional distance between participants in videoconferencing, can be improved depending on the technical design of the videoconferencing room. With business and educational demands increasing the need for videoconferencing technologies and its cost-saving and time-saving benefits, it is critical that the participant experience be improved. By shifting the design of videoconferencing rooms from a technology-centric view to a more collaborative-centric view, end-user satisfaction will improve.

With increasing business and educational needs for the abilities to collaborate effectively with clients, vendors, and colleagues in regional, national, and international settings, organizations will continue to look to videoconferencing to meet this demand. Videoconferencing offers the opportunity to fully collaborate and communicate with geographically dispersed participants in a collaborative environment that fully meets the participants’ needs, if the rooms are designed and implemented with a focus on collaboration and not technology.
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Experience.


http://blogs.forbes.com/kymmcnicolas/2010/08/19/clean-up-your-office/?partner=yahootix


APPENDIX A: Videoconferencing Technical Survey
Q1. The following series of questions will be used for demographic analysis.

Which of the following best describes the primary industry of your organization.

- Government
- Educational
- Legal
- Business
- Other

Q2. What is your age range?

- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- 71 +

Q3. What is your gender?

- Male
- Female

Q4. Which of the following best describes your role in video conferencing support?

- Conference Engineer
- Design and integration
- Conference Operations
- Management
- Technician
- Vendor
- Other

Q5. How many years have you worked in the video conferencing industry?

Q6. Please list any degrees or applicable industry certifications you hold. (Check all that apply.)
Q7. How many employees are in your organization? (Leave blank if you do not know)

Q8. How many employees are in your IT Division or IT Support Unit? (Leave blank if you do not know)

Q9. How many employees directly support video conferencing at your organization? (Leave blank if you do not know)

Q10. How many video conferencing enabled meeting rooms does your organization support or work with? (Leave blank if you do not know)

Q11. In what year was your latest video conferencing room installed?

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Q12. What sources do you utilize most to learn about new technologies, concepts, and available features in the video conferencing industry? (Please select all that apply.)

- [ ] On-the-Job Training
- [ ] Conferences
On-Site Classes
  On-line Training Materials

Q13. When did you last attend a conference or training on new technologies, concepts, or available features in the video conferencing industry?

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Q14. In thinking of video conferencing room design and installation in general, please rate how often the following factors are incorporated in the final room design.

<table>
<thead>
<tr>
<th>Placement of viewing monitors or screens determined to allow for optimal viewing of remote participants.</th>
<th>Always</th>
<th>Frequently</th>
<th>Sometimes</th>
<th>Never</th>
<th>Not Applicable</th>
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<tbody>
<tr>
<td>Size of viewing monitors or screens determined to allow optimal viewing of remote participants.</td>
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<td>Size of the image displayed on the viewing monitor or screen configured for optimal viewing of remote participants.</td>
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<td>Push-to-talk microphones connected with cameras that have Pan-Tilt-Zoom features are used to improve viewing of person speaking.</td>
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<td>In larger video conferencing rooms, wireless microphones are provided to allow the presenter to move around freely.</td>
<td>Always</td>
<td>Frequently</td>
<td>Sometimes</td>
<td>Never</td>
<td>Not Applicable</td>
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<td>Gaze angle is a primary factor for placement of the presenter camera.</td>
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<td>Digital Ceiling Microphones can be used to make communication easier among participants.</td>
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Q15. In thinking of video conferencing room design and installation in general, were there collaborative tools or best-practices configurations not included due to external factors such as...

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<thead>
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<th></th>
<th>Always</th>
<th>Frequently</th>
<th>Sometimes</th>
<th>Rarely</th>
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<tr>
<td>Budget Constraints</td>
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<td>Restrictions Caused by Existing Room Structure</td>
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<td>Client Requests</td>
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<tr>
<td>Other Restrictions</td>
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Q16. In thinking of the latest video conferencing room designed and installed by your organization, the overall configuration of audio, monitors, and how distant images are displayed in the videoconferencing room provides for participants to feel more connected among the sites.

- [ ] Yes
- [ ] Probably Yes
- [ ] No reliable method to determine this from the technical side

Q17. In thinking of the latest video conferencing room installed by your organization, which microphone system was installed?

- [ ] Desktop Microphones
- [ ] Ceiling Microphones
- [ ] Handheld Microphones
- [ ] Desktop Microphones which activate Pan-Tilt-Zoom control on Cameras
- [ ] Combination of Microphone Systems

Q18. In thinking of the latest video conferencing room installed by your organization, which camera system was installed?

- [ ] Stationary Camera
- [ ] Pan-Tilt-Zoom Camera with manual control
- [ ] Pan-Tilt-Zoom Camera which automatically locates individual speaking
- [ ] Pan-Tilt-Zoom Camera which is controlled by secondary system (i.e. Crestron or AMX)
- [ ] Other

Q19. In thinking of the latest video conferencing room installed by your organization, what is the distance of the presenter camera from the remote-viewing display?

- [ ] Mounted Adjacent to Remote-Viewing Display
- [ ] Mounted Within 1 Foot of Remote-Viewing Display
- [ ] Mounted Within 1-2 Feet of Remote-Viewing Display
- [ ] Mounted Within 2-3 Feet of Remote-Viewing Display
- [ ] Mounted Greater than 3 Feet from Remote-Viewing Display
- [ ] Other
Q20. When connecting video conferencing sessions, which viewing setting do you utilize most often?
- [ ] Continuous Presence
- [ ] Lecture Mode
- [ ] Video Switching
- [ ] Transcoding
- [ ] Other

Q21. When determining which viewing setting to utilize do you discuss preferences with the end-users?
- [ ] Yes, always discuss with participants to select best method
- [ ] Frequently discuss with participants to select best method
- [ ] Best method is determined by method which uses least amount of bandwidth
- [ ] No, Technical Team makes decision
- [ ] Other

Q22. In addition to the standard video conferencing equipment, what other multi-media technology do you install on a regular basis in a video conferencing room? (Check all that apply.)
- [ ] Video Tape Player/Recorder
- [ ] DVD Player/Recorder
- [ ] Blu-Ray Player
- [ ] Document Camera
- [ ] Stationary or Fixed Room Computer
- [ ] Laptop Connectivity
- [ ] Internet Connection
- [ ] Interactive Whiteboard
- [ ] Touch Panel Control System
- [ ] Other
- [ ] Other

Q23. Would you be willing to be contacted for an interview regarding video conferencing room design and configuration? If so, please email Tamela.Smyth@wku.edu directly so there will be no link and your responses will remain anonymous.
APPENDIX B: End-User Survey

Qualtrics Survey Software  Page 1 of 3

Interactive Video Services Room Configuration Pilot Survey

Default Question Block

How many years have you taught in post secondary education?

How many distance learning courses have you taught using the video conferencing technology, also referred to as interactive television, ITV or IVS technology?

What college do you teach in?
- College of Education and Behavioral Sciences
- College of Health and Human Services
- Gordon Ford College of Business
- Ogden College of Science and Engineering
- Potter College of Arts & Letters
- University College
- Gatton Academy of Mathematics and Science
- Honors College
- Other

What age range are you?

<table>
<thead>
<tr>
<th>Age Range</th>
<th>21 - 30</th>
<th>31 - 40</th>
<th>41 - 50</th>
<th>51 - 60</th>
<th>61 - 70</th>
<th>71 +</th>
</tr>
</thead>
<tbody>
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<td>21 - 30</td>
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</tbody>
</table>

What is your gender?
- Male
- Female

Please provide your opinions on the following statements as they relate to the configuration and placement of cameras, microphones and viewing monitors in the interactive television/video conferencing classroom that you primarily teach from:

<table>
<thead>
<tr>
<th>The placement of monitors or screens in the IVS classrooms allows for you optimal viewing</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>
Please indicate your level of satisfaction with each of the following based on your experiences in the IVS classroom:

<table>
<thead>
<tr>
<th>Communication levels between you and your students in an IVS class?</th>
<th>Very Satisfied</th>
<th>Satisfied</th>
<th>Neutral</th>
<th>Dissatisfied</th>
<th>Very Dissatisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>How clearly you and your students understanding meanings in an IVS class?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Closeness between you and your students in an IVS class?
How well do you work together between or across the sites?

Please add any additional comments you would like to make regarding your sense of closeness and collaboration provided within the IVS environment.

Would you be willing to be contacted for an interview regarding video conferencing room design and configuration? If so, please email Tamela.Smith@wku.edu directly so there will be no link and your responses will remain anonymous.

- Yes
- No
APPENDIX C: Videoconferencing Professional Cover Letter

Greetings:

There have been many advances in recent years in the technology used in video conferencing room design. Current video conferencing room design and installations include H.323 technology, high-definition capabilities and advanced audio systems. While these advanced technological rooms are used for meetings, educational courses, legal proceedings and a variety of utilization, limited research has been conducted to correlate video conferencing room technical design with the levels of collaboration needed for clients.

As a member of the Visual Communications Industry Group, you are a recognized leader in the video conferencing industry and are therefore being asked to provide your valuable insight into this research. All survey responses are anonymous and all results will be reported in summary form to protect confidentiality. The survey results will be available to participants, upon request.

The Video Conferencing Technology study is an online survey administrated to individual participants through the survey research system called Qualtrics and should take approximately 10 minutes to complete. Your participation in this study will provide important data to further the research in this growing and changing industry.

This study is being used to collect data for a dissertation which will be used as partial fulfillment of the requirements for a Doctorate in Educational Leadership. The survey was reviewed and approved by the WKU Institutional Review Board (IRB) on 03/06/2013 and participation is voluntary. Should you choose to participate, you may withdraw at any point in the survey with no penalty. No information connecting individual participants with collected data will be gathered. There are no known discomforts or risks associated with participation in this survey research process. There are no anticipated benefits to individuals participating in this survey research, other than the potential to add to the knowledge base for research in any associated areas.

The following link will take you to the survey. Following this link constitutes your implied voluntary consent to complete the survey: (LINK)

Any comments or questions on this study may be directed to the principle investigator Tamela W. Smith, Manager, Communication Technologies-Interactive Video Services at Western Kentucky University. Ms. Smith may be reached at 270-745-5523 or via email at Tamela.Smith@wku.edu. Your participation and opinions/comments will help to strengthen the research in this important field and are greatly appreciated. Thank you.

[Signature]

Tamela M. Smith

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APPENDIX D: End-User Cover Letter

Dear Interactive Video Services Faculty Member:

While there have been many advances in recent years in the technology used in video conferencing, limited research has been conducted to ensure the technical design and implementations provide the highest levels of collaboration, as required for faculty and students in an educational setting.

As a faculty member who is currently teaching a course in a video conferencing (IVS) classroom, you are being asked to provide your valuable insight into this study. The Video Conferencing Technology study is an online survey administrated to individual participants through Qualtrics. This study will be used as part of a dissertation toward fulfilling the requirements of a Doctorate in Educational Leadership.

The survey was reviewed and approved by the WKU Institutional Review Board (IRB) on 03/6/2013 and participation is voluntary. Should you choose to participate, you may withdraw at any point in the survey with no penalty. All survey responses are anonymous and all results will be reported in summary form to protect confidentiality. There are no known discomforts or risks associated with participation in this survey research process. There are no anticipated benefits to individuals participating in this survey research, other than the potential to add to the knowledge base for research in any associated areas.

The following link will take you to the survey. Following this link constitutes your implied voluntary consent to complete the survey:

Any questions, comments, or feedback on this survey may be directed to me, Tamela Smith, Manager, Communication Technologies-Interactive Video Services, at Western Kentucky University. I may be reached at 270-745-5523 or via email at: Tamela.Smith@wku.edu

[Signature]

THE DATED APPROVAL ON THIS CONSENT FORM INDICATES THAT THIS PROJECT HAS BEEN REVIEWED AND APPROVED BY THE WESTERN KENTUCKY UNIVERSITY INSTITUTIONAL REVIEW BOARD
Paul Mooney, Human Protections Administrator
TELEPHONE: (270) 745-2129
APPENDIX E: IRB Stamped Approval

WESTERN KENTUCKY UNIVERSITY
Institutional Review Board
Continuing Review Report

Name of Project: Video Conferencing Technology Survey
Name of Researcher: Tamela Smith
Department: Educational Leadership

How many total subjects have participated in the study since its inception? #45

How many subjects have participated in the project since the last review? #45

Is your data collection with human subjects complete? ☐ Yes XX No

1. Has there been any change in the level of risks to human subjects? (If “Yes”, please explain changes on a separate sheet). ☐ Yes XX No

2. Have informed consent procedures changed so as to put subjects above minimal risk? (If “Yes”, please describe on a separate sheet). ☐ Yes XX No

3. Have any subjects withdrawn from the research due to adverse events or any unanticipated risks/problems? (If “Yes”, please describe on a separate sheet). ☐ Yes XX No

4. Have there been any changes to the source(s) of subjects and the Selection criteria? (If “Yes”, please describe on a separate sheet). ☐ Yes XX No

5. Have there been any changes to your research design that were not specified in your application, including the frequency, duration and location of each procedure? (If “Yes”, please describe on a separate sheet). ☐ Yes XX No

6. Has there been any change to the way in which confidentiality of the Data is maintained? (If “Yes”, please describe on a separate sheet). ☐ Yes XX No

7. Is there a desire to extend the timeline of the project? ☐ Yes XX No
   On what date do you anticipate data collection with human subjects to be completed? 12/15/2013

Description of Survey Changes – IVS Faculty Pilot Survey
*Survey shortened from 15 to 10 questions
*Added two demographic questions:
Q5: How many years have you worked in the video conferencing industry?
Q6. Please list any degrees or applicable industry certifications you hold? (Check all that apply.)

WKU IRB# 13-209
Approval - 3/6/2013
End Date - 12/31/2013
Expedited
Original - 2/11/2013