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ABSTRACT

THE EFFECTS OF A VIDEOCONFERENCING IMPLEMENTATION
PROJECT ON EDUCATORS' LEVEL OF CONCERN
IN SOUTHWEST MICHIGAN SCHOOLS

by

Dennis David Lundgren

Chair: Shirley Freed

ABSTRACT OF GRADUATE STUDENT RESEARCH

Dissertation

Andrews University

School of Education

Title: THE EFFECTS OF A VIDEOCONFERENCING IMPLEMENTATION PROJECT ON EDUCATORS' LEVEL OF CONCERN IN SOUTHWEST MICHIGAN SCHOOLS

Name of researcher: Dennis David Lundgren

Name and degree of faculty chair: Shirley A. Freed, Ph.D.

Date completed: March 2012

Problem

Two-way, interactive videoconferencing is emerging as an important technology tool for K-12 educators. The challenge is to identify and describe successful implementation. Educator concerns related to implementation may inhibit success. The focus of this study of a federally funded videoconferencing project is to address the factors that influence educators' level of concern.

Method

The Concerns-Based Adoption Model (CBAM) Stages of Concern (SoC) instrument was administered to measure the level of concern of two cohorts of participants. Data related to project, including number of connections, district and

building technical support, professional development, and equipment reliability were also collected. One-way repeated measures of analysis of variance was used to determine if change took place in the Stages of Concern responses while canonical correlation and multiple regression were used to examine the relationship between level of concern and factors thought to be related to project implementation (e.g. number of connections, equipment reliability, etc.).

Results

Overall, approximately 86% of the participants were at levels 1-3 on the measure of levels of concern at the beginning of the project. At the end of the project implementation period (at posttest), about 84% were at levels 4-5. Canonical correlation analysis indicated that level of concern and number of connections were significantly associated with professional development hours, building tech support and equipment reliability ($r_c = 0.81$, $p = 0.001$). Higher levels of concern (-0.88) and a larger number of connections (-0.71) are associated with higher professional development hours (-0.60), better building tech support (-0.42), and higher equipment reliability (-0.69). However, equipment reliability ($\beta = 0.59$) is the best predictor of participants' level of concern. By itself, equipment reliability accounted for 42% ($r = 0.65$) of the variance in participants' levels of concern.

Conclusions

The activities in the project in this study resulted in improved levels of concern for the project participants. Improved levels of concern and increased number of connections result from higher levels of equipment reliability, adequate building-level technical support, and a high level of professional development with equipment reliability

having the most impact. It is essential that as videoconferencing projects are

implemented, leaders at all levels address these factors.

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Andrews University

School of Education

THE EFFECTS OF A VIDEOCONFERENCING IMPLEMENTATION
PROJECT ON EDUCATORS' LEVEL OF CONCERN
IN SOUTHWEST MICHIGAN SCHOOLS

A Dissertation

Presented in Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

by

Dennis David Lundgren

March 2012

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APPROVAL BY THE COMMITTEE:

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Chair: Shirley A. Freed   Dean, School of Education
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Member: Dennis W. Rudy

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External: John Van Dyke   Date approved

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ACKNOWLEDGMENTS

This study began with the wonderful opportunity to lead the Instructional

Technology Department at the Berrien Regional Education Service Agency in Michigan.

I thank Berrien RESA's former instructional technologist and friend Dr. Janine Lim for

her enthusiastic support and the knowledge she shared with me on this topic.

Thank you to my advisor and committee chair Dr. Shirley Freed and committee

members Dr. Jimmy Kijai and Dr. Dennis Rudy, for your feedback, encouragement, and

guidance. I thank many others who have supported me in this effort including Leadership

Department faculty and staff, especially Dr. Robson Marinho for his guidance early on in

the study. I appreciate the support of my leadership and learning group, and my friends

and colleagues.

I give a special thank-you to my wife, Colleen, for her support and assistance in

completing this dissertation and helping me reach my goals by supporting me throughout

my educational journey. And I thank my son, David, as he has encouraged and motivated

me through this process as well.

CHAPTER 1

INTRODUCTION

Background to the Problem

Educational technology has become a universal ingredient in the fabric of schools. Educators increasingly embrace and use a number of technologies because students' technological skills have become survival skills in a global economy (Donlevy, 2005). Applications of technology in education can be seen worldwide as educators work to meet the challenge of implementing technology as an educational tool (Al-Awani, 2005; Gaines, 2002; Masalela, 2006).

The implementation of new technology is often difficult due to the various concerns of educators (Wexler, 2003). These concerns are created by factors that include availability of equipment (Malinski, 2000; Masalela, 2006), adequate training (Cassell, 2005; McDavid, 2003), reliability of equipment (de la Garza, 2006, Sandholtz, Ringstaff, & Dwyer, 1997), time for practice and to gain experience (Masalela, 2006; Sandholtz et al., 1997), technical support in the school building (McDavid, 2003), and the general fear and discomfort associated with new technology (Wexler, 2003). It is widely recognized that educators often experience fear and discomfort that impacts their level of concern when facing the prospect of implementing a new technology (Wexler, 2003; Westergaard, 1999). In addition, there are concerns related to leadership from technology experts and administration (Ely, 1990; Masalela, 2006; Sandholtz et al., 1997). These

concerns of those implementing new technology become barriers and limit the extent to which new technology is implemented and sustained.

In light of these concerns, we find that the Concerns-Based Adoption Model (CBAM) has been used since the 1970s to guide the adoption of educational innovations in a number of settings. The development of the model took place at the University of Texas Research and Development Center for Teacher Education. Developers included Fuller (1969); Hall, Wallace, and Dossett (1973); and Hall, Loucks, Rutherford, and Newlove (1975). The CBAM model includes four components: Innovation Configurations, Stages of Concern, Levels of Use, and Intervention Taxonomy. The model is based on the connection between the educational innovation and the concerns of those involved in the implementation of the innovation.

The CBAM component that measures the level of concern regarding the implementation of an innovation is the Stages of Concern (SoC) instrument. The SoC has been used in a number of studies involving technology implementation to assess the level of concern of the participants (Davis & Roblyer, 2005; Gershner & Snider, 2001; Christou, Eliophotou-Menon, & Philippou, 2004).

One specific technology currently being implemented in some public schools is videoconferencing. Videoconferencing connects individuals or groups in one location through real-time voice and data with individuals or groups at another location. In the school setting, videoconferencing connects individuals in one location to individuals at a remote location. The remote location may be anything from a school building across the street to a museum's educational program half a world away. Videoconferencing permits video and sound to be interactively and simultaneously shared between two or more sites.

In the example of the museum connection, it is possible for several school buildings to interact with the museum and the other participating classrooms. Using the Internet or dedicated telephone circuits, these connections are live, allowing people to interact across space in a real-time environment (Newman, 2008). Videoconferences are conducted with students for instruction and to connect to the curriculum, or for staff in the context of training and professional development. As an additional resource for the school, videoconferencing can effectively serve as a medium to implement professional development (Fadale, 1999).

Several formats for student videoconferences exist. Keefe (2003) explains, "Videoconferencing technologies permit students to interact with other students or with remotely located experts in laboratories, field research sites, museums or classrooms" (p. 7). Classroom to classroom connections are used to bring students together for sharing information or to work on common projects. This type of videoconference can involve two or more classrooms within a school district or anywhere in the world. This type of videoconferencing use is known as *curriculum videoconferencing* (Lim, 2009). Curriculum videoconferencing includes activities or programming that is directly related to the curriculum activities in the school. It represents one aspect in a global trend to integrate technology in education settings. There are instances where videoconferencing has been employed in the classroom to connect students globally (Cifuentes & Murphy, 1999; Marek, 2008; Mizell, 1999). Videoconferencing is one of several mediums to support virtual learning with connections to the curriculum, and it is growing in use as an educational tool (Greenberg, 2009).

The student utilizing virtual learning is the real source of innovation (Cappon,

2002), but support mechanisms are required to make this possible. The implementation of this specific type of technology, videoconferencing, elicits the same concerns for educators as other technologies introduced in a school setting. The implementation of videoconferencing is often difficult due to the various concerns of educators, and there is general fear and discomfort associated with the new technology (Habash, 1998; McCartan, 2005).

Schools struggle with issues of implementation of videoconferencing as both pedagogical and technical strategies continue to be developed. Successful implementation of videoconferencing, making meaningful connections consistently, is dependent on the availability of the equipment and connections. Access to equipment is critical for successful implementation (Masalela, 2006). A robust infrastructure is required in order to implement virtual learning through videoconferencing (Gaines, 2002). This infrastructure speaks to the availability of equipment and the reliability of the equipment (Malinski, 2000; Masalela, 2006) as well as an expectation that the equipment will work properly for each conference (Westergaard, 1999). The issue of reliability of equipment relates to a number of factors that impact implementation. Reliability includes videoconferencing units working properly and that connections are dependable and consistent in order to be effective. Reliability also is apparent in videoconferencing units that operate so the technology is transparent. Reliable equipment allows the user to place the focus on the content of the conference rather than on the equipment. In order to have a successful connection, there are other pieces of technology along the communication line that affect reliability. An array of technical equipment and Internet or telephone connections line up to assure communication in a videoconference. This brings into play

the technical support staff and others who provide necessary support. The videoconference coordinator and the classroom teacher depend on individuals who have the expertise to see that all the components work properly. Equally important is the timeliness of technical assistance because videoconferences are often on a strict schedule.

Just as with other technology implementations, adequate training and professional development are factors in the implementation of videoconferencing (Baker, 2002; McDavid, 2003), and educators are challenged to find practice time with the technology (Masalela, 2006; Pachnowski, 2002). Educators need training, support, and opportunities to utilize videoconferencing with confidence (Giuliani, 2001; Malinski, 2000). New technology requires new skills, yet training and professional development are often limited. Baker (2002) suggests that training and professional development must also be sustained so that skills are learned and reinforced to the point that educators can implement the technology effectively.

A climate that allows educators to implement new technologies with administrative support and adequate budget is a concern for successful use of technology including videoconferencing implementation. Climate issues point to questions related to support. How is the use of technology in instructional practice accepted and valued by school administration, faculty, and technical support staff? Does the school commit the necessary resources to support implementation, including the equipment and infrastructure to make videoconferencing possible?

Context of the Study

In February 2005, the Berrien County Intermediate School District (BCISD) in Michigan received a $350,000 United States Department of Agriculture (USDA) Rural

Utilities Services (RUS) Distance Learning and Telemedicine Grant. The grant award allowed BCISD to purchase videoconferencing units and supporting equipment for 35 elementary and middle schools in Berrien and Cass counties. These schools had been identified as rural and low income. The grant recipient is required to expend matching funds of at least 50% of the award amount, and BCISD provided matching funds for the equipment needed to facilitate multiple connections among the 35 schools. In this study, this federal grant and associated activities will be referred to as the Project.

In the third year of the RUS grant project, the Berrien County Intermediate School District changed the organization's name to the Berrien Regional Education Service Agency with a shortened, commonly used name, Berrien RESA. The name Berrien RESA will be used in this study to reference the organization.

Before the award of the grant, approximately 35 buildings in southwest Michigan had implemented videoconferencing with the majority of units in high-school buildings. In most local districts, elementary or middle-school classrooms were bussed to the high school to participate in videoconferences. With difficulties of arranging transportation and the increasing demand for videoconferencing, few classrooms traveled to participate in videoconferences. The rationale for seeking the USDA grant was to provide support for the middle and elementary schools. In the contract with local districts, the Berrien RESA stated, "The primary goal of this project is to bring distance learning opportunities to students who find it difficult to access distance learning at the current high school distance learning lab" (Berrien County Intermediate School District, 2006, p. 1).

In each building, the specific equipment included a Polycom VSX 7000s videoconferencing system, an Olevia 37-inch LCD display, a VFI C2736-42 mobile cart,

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an Avermedia QuickPlay scan converter, and a document camera. A few school districts

also received a firewall to reduce connection problems. Firewalls are devices installed

between the Internet and other external sources and the organization's internal network.

The purpose of the firewall is to protect a network from outside attacks or intrusions.

Because videoconferencing requires an unrestricted path to the Internet or other

networks, specific settings are required to allow access and at the same time protect the

network. Local buildings received assistance from Berrien RESA in installing these

systems. In some cases, network equipment was supplied with grant dollars to overcome

network traffic or firewall issues. The grant funding also provided 3 years of warranty

and technical support from the vendor.

This influx of new technology immediately created a challenge for the newly

appointed videoconferencing coordinators, key contacts in each building. The Project

heavily relied on these individuals as they were responsible for the location and operation

of equipment and they assisted in the scheduling and logistics of connections.

Videoconferencing coordinators also assisted the classroom teachers as they participated

in videoconferences in their classrooms or a videoconferencing room in their building.

Classroom connections were made to various providers such as authors, zoos, and

museums. Classroom-to-classroom connections occurred within the Berrien RESA

service area, as well as worldwide.

All Project participants possessed some familiarity with videoconferencing

before the start of the grant and grant activities but lacked specific skills to use the

equipment effectively. They were also unaware of the variety of program providers and

did not know how to arrange connections with the providers. The videoconferencing

coordinators faced the challenge of assisting classroom teachers in the planning, organizing, and conducting connections with providers or other classrooms. This lack of knowledge and experience raised the concern level of the participants.

There was also a Project requirement for participants to receive professional development. The professional development included initial face-to-face training at the Berrien RESA facility for videoconferencing coordinators, periodic training videoconferences with the grant coordinator for all participants, and long courses delivered in an online format with a duration of several weeks to a semester in length (Berrien Regional Education Service Agency, 2009).

As a training exercise, videoconferencing coordinators and teachers were required to connect with other educators through videoconferencing. These connections were made so that participants could share experiences, discuss implementation challenges, and share ideas. This gave the educators practice with the technology and provided an efficient medium to learn from one another.

The implementation of the Project required that the staff, principals, technology directors, and the video conferencing coordinators participate in training. The training of all the stakeholders involved in the implementation of the Project was required to both provide technical training and to define roles and responsibilities to ensure the sustainability of the project. The design of the Project distributed operational responsibilities among principals, technology directors, videoconferencing coordinators, and teachers.

The level of training for the videoconferencing coordinators was much more rigorous than the training for principals, technology directors, and teachers involved in

implementation. The coordinator's additional training included the process of scheduling

programs, detailed instruction on searching for programming, more detailed instruction

on the operation of the equipment, and training on troubleshooting equipment and

training related to the operation of the Berrien RESA videoconferencing database of

activities. The Berrien Regional Educational Service Agency's Department of

Instructional Technology provided leadership, professional development, technical

training and practice, and operational support to each building.

Statement of the Problem

Two-way, interactive videoconferencing is emerging as an important technology

tool for K-12 educators. Schools are making significant investments in equipment,

infrastructure, and personnel. However, these investments do not necessarily guarantee

successful, sustained implementation. Barriers related to implementation factors may

inhibit success. The challenge is to identify and describe successful implementation, to

address the factors that influence educators' level of concern, and to describe the critical

variables (factors) required for the successful implementation of curriculum

videoconferencing.

Purpose Statement

The purpose of this study was to determine what factors predict levels of

successful implementation of videoconferencing by participants in the Project and to

determine participants' change in the level of concern with the implementation of the

grant activities.

Research Questions

This study examines several factors that affect the number of conferences in a building involved in a federal grant. The study also considers the levels of concern related to using videoconferencing and if the level of concern is reduced through participation in the federal grant.

In addition to the levels of concern and the number of connections, the study includes the factors of equipment reliability, technical support at the building-level, technical support at the district-level, and the participation in training and professional development. Thus, the following research questions were formulated related to the factors examined in the study.

1. To what extent does program implementation impact levels of concern?

2. What is the nature of the relationship between a linear combination of levels of concern and number of connections and the linear combination of professional development hours, equipment reliability, building-level technical support, and district-level technical support?

3. In addition to professional development hours, equipment reliability, building-level technical support, and district-level technical support, to what extent is the number of connections related to the level of concern?

Rationale for the Study

As curriculum videoconferencing in the classroom is a new technology compared to other technologies used in schools, the body of research around the implementation of videoconferencing is limited. Research does exist regarding defining videoconferencing (Hahn, 2008; Newman, 2008), instruction and curriculum integration methods (Baker,

2002; Giuliani, 2001; Keefe, 2003), and videoconferencing in higher education (McCartan, 2005). However, research targeting the factors that support successful implementation of curriculum videoconferencing provide a benefit for those institutions that embark on utilizing videoconferencing in a school setting.

The federal grant in this study required that data be collected for a program evaluation at the end of the project. The program evaluation of this project was published as a summary of activities. A more focused study based on project data adds knowledge to the field of videoconferencing implementation.

The factors that affect the level of concern of educators as they implement technology have been noted in the literature. However, research connecting the technology implementation factors and the level of concern educators experience has not been conducted. The study of the connection of educators' level of concern and implementation factors is beneficial to the field and assists in future videoconferencing implementation efforts.

Theoretical Framework

The application of a theoretical framework provides guidance in pursuing a research effort. According to Anfara and Mertz (2006), "a theoretical framework has the ability to (1) focus a study, (2) reveal and conceal meaning and understanding, (3) situate the research on a scholarly conversation and provide a vernacular, and (4) reveal its strengths and weaknesses" (p. 192). In this study, Owston (2007) provides a theoretical framework through his model for sustainability of classroom innovation. Figure 1 represents Owston's (2007) model with the connections to variables and Project elements in this study. Project elements are listed below each of Owston's elements in Figure 1.

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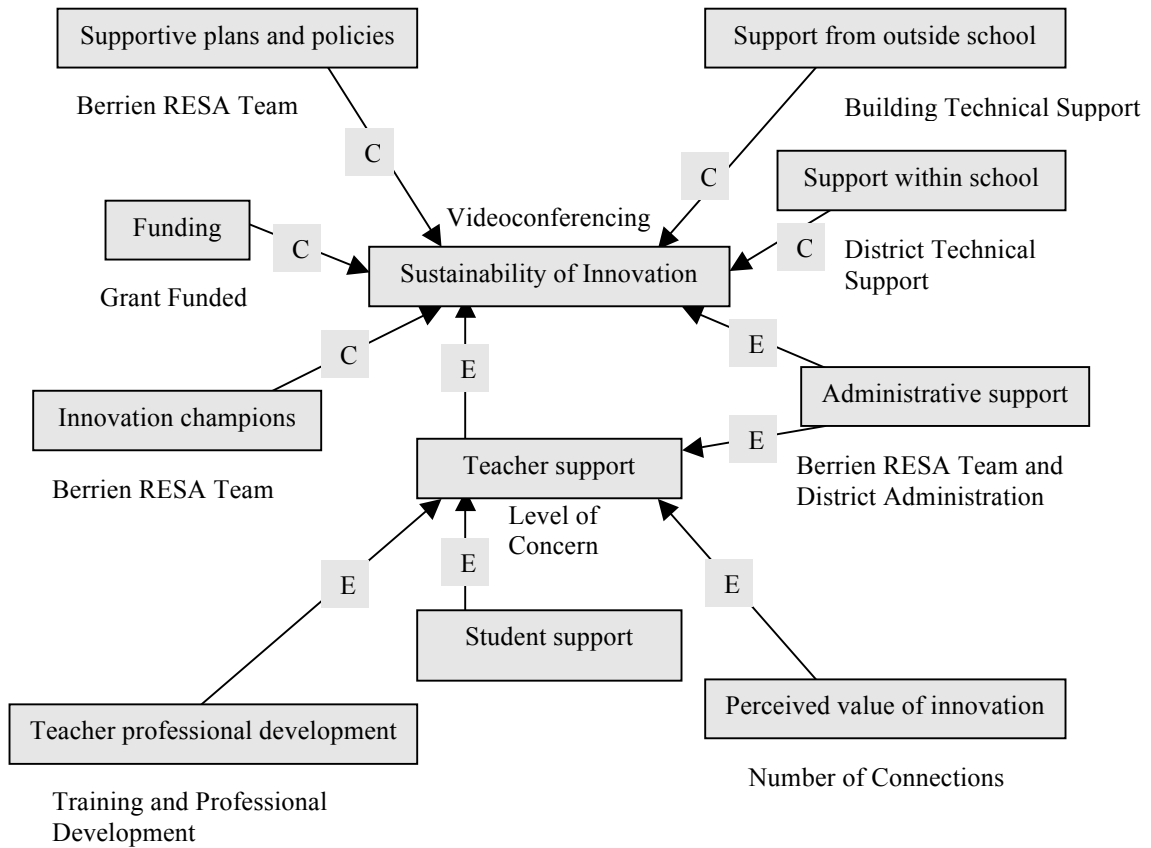
Figure 1. Owston's model for sustainability of classroom innovation (Edited). E indicates essential elements and C indicates contributing elements. Elements of this study are inserted into the model directly below each of Owston's elements. From "Contextual Factors That Sustain Innovative Pedagogical Practice Using Technology: An International Study," by R. Owston, 2007, *Journal of Educational Change, 8*, p. 68. Copyright 2007 by Springer Science+Business Media.

A dilemma facing the implementation of an innovation is identification of the elements for success and the sustainability of the change and innovation. Sustainability creates a system that supports the innovation. Owston's (2007) model examines a number of factors that contribute to this sustainability. These are divided into essential factors and contributing factors. Contributing factors (C) include supportive plans and policies,

support from outside the school, support from inside the school, funding, and innovation champions. Essential (E) factors include teacher professional development, student support, teacher support, administrative support, and the perceived value of the innovation. These factors align with the concerns and barriers to the implementation of technology, including videoconferencing, outlined earlier in this chapter.

The identification of important factors in instituting innovation is at the heart of Owston's (2007) model. His model is based on 59 school sites that continued an innovative project for at least 2 years. The factors he identified in his model were included if the factor was evident in 50% of the school sites. His model is described in greater detail in Chapter 2.

The Owston model focuses not only on successful implementation but also the sustainability of the implementation. Fullan (2005) connects sustainability as a function of leadership that can be found in elements of Owston's model. Hargreaves and Fink (2005) state that sustainable leadership is distributed rather than delegated. It is a social activity that stretches across many people. Owston distributes leadership in his model in elements such as administrative support and school-level support.

In the context of this study, the work of the Project, while providing necessary equipment, also provided extensive capacity development through training, classes, and mentoring. As demonstrated by Owston (2007) these factors contribute to the sustainability of the technology innovation, in this case, videoconferencing. The implementation of the Project involved elements of Owston's (2007) model by providing training and support to principals, technology directors, teachers, paraprofessionals, media specialists, and other key individuals in the schools. The Project created a system

that put in place the means to develop the implementation of videoconferencing and to support use of videoconferencing to make connections tied to the curriculum. The activities of the Project connect to much of Owston's model in terms of equipment reliability, technical support at school and district levels, training and professional development, all touching the level of concern of educators.

Research Design

The research used a single group pretest, posttest design to study the implementation of a federal grant awarded to the Berrien Regional Educational Service Agency in Michigan. This design allows the research to compare the group before and after treatment (I. Newman, C. Newman, Brown, & McNeely, 2006). The focus of the study was on the videoconferencing coordinators and educators involved in the implementation of videoconferencing.

At the initial professional development activity, all participants completed the Stages of Concern (SoC) questionnaire based on the Concerns-Based Adoption Model (CBAM). Participants completed the SoC at the end of the first year of implementation and a posttest with the identical SoC at the end of each of the following 2 years.

Along with the SoC, the participants responded to open-ended survey questions with participants providing their perceived barriers to implementing videoconferencing in the school setting and to express their perceived needs for professional development to become more proficient in the use of videoconferencing.

Additional data collected included the number of conferences completed, the reliability of equipment expressed in the percentage of time the equipment ran without failure, the level of school building technical support, the level of district-wide technical

support, and the number of contacts with Berrien RESA.

Definition of Terms

This study focuses on factors that impact the implementation of videoconferencing. The discussion on this topic requires the use of terms specific to this technology and this study. This section defines terms used in the discussion of videoconferencing in schools.

Berrien County Intermediate School District (BCISD)

BCISD is an education service agency for K-12 schools and school districts in Berrien, Cass and Van Buren counties. The district supports local districts through services that include special education schooling and consulting, assistance with state and federal requirements, support for low performing schools, general curriculum training, technology support, and other similar activities. In the third year of the Project, BCISD changed the name of the school to the Berrien Regional Education Service Agency or Berrien RESA.

Berrien Regional Education Service Agency (Berrien RESA)

Berrien RESA was formerly the Berrien County Intermediate School District. The functions of the district were unchanged.

Classroom-to-Classroom Connections

Videoconferences may interactively connect students in one location with students in a different location. This may be in the same building or on the other side of the world. It allows students at different locations to interact with each other in real time. These connections may involve a small number of children or an entire classroom.

Concerns-Based Adoption Model (CBAM)

CBAM is the Concerns-Based Adoption Model developed at the University of Texas Research and Development Center for Teacher Education. While there are several components to this model, this study involved one part of the model indicating each participant's level of concern. A draft of the instrument is found in Appendix A.

Curriculum Videoconferencing

Curriculum videoconferencing provides interactive learning experiences directly to students (Lim, 2009). It is intended to enhance student learning within a content area in a school setting often at the classroom level. These applications of videoconferencing may include connections with zoos, museums, authors, topic experts, or connections with others (Keefe, 2003; Lim, 2009).

Implementation Success

As defined in the Project specifications, successful implementation is at least five videoconferences annually per building as indicated by the count data collected by the Project implementation team (Berrien County Intermediate School District, 2006). For the purpose of this study, buildings with higher count data would indicate a higher level of success.

Integrated Services Digital Network (ISDN) Connections

These connections are commonly referred to as ISDN. ISDN is a type of connection that utilizes a telephone line. This line is a dedicated telephone circuit for point-to-point communication to prevent other signals from interfering with the connection and to ensure a continuous connection.

Internet Protocol (IP) Connections

IP is an acronym for Internet Protocol. IP is a system that permits various end points to communicate over the Internet. IP connections, then, are videoconferencing connections utilizing the Internet.

Rural Utilities Services (RUS)

Rural Utilities Services is a branch of the United States Department of Agriculture and the source of the federal grant referenced in this study. The federal grant to Berrien RESA received from RUS was titled the Distance Learning and Telecommunications Grant (Berrien County Intermediate School District, 2006). These grants are primarily awarded to schools and medical institutions.

Stages of Concern Questionnaire

The Stages of Concern questionnaire (SoC) is the element of CBAM used in this study. The Stages of Concern questionnaire is an instrument that allows individuals to self-select the level of concern related to their experience with a specific application of technology. While the full questionnaire utilizes 39 questions, the SoC is often reduced to seven stages to fit the needs of a given project. The Stages of Concern questionnaire used in this study is in Appendix A.

Two-way, Interactive Connections

This type of videoconferencing allows video and sound to be interactively and simultaneously shared between two or more remote groups. These connections are live, providing a real-time environment (Newman, 2008).

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United States Department of Agriculture (USDA)

The United States Department of Agriculture is an agency of the United States executive branch of government. It is a federal department that, through RUS, provided the funds for the grant referenced in this study.

Videoconferencing

A videoconference allows two parties in separate locations to be connected by a device that provides picture and sound (Hahn, 2008). For the purpose of this study, videoconferencing involves IP and ISDN connections for classroom use.

Videoconferencing Coordinator

The videoconferencing coordinator is an educator in a school building responsible to schedule and manage two-way, interactive connections. The coordinator also provides leadership in the building in the implementation of videoconferencing.

Virtual Field Trip

Various content providers such as laboratories, field research sites, museums, or other organizations permit students to interact with individuals at that site (Keefe, 2003). Rather than loading students onto a bus and driving to a site such as a museum, students are transported virtually through interactive videoconferencing connections.

Delimitations of the Study

The data for the study were existing data gathered by the Berrien Regional Education Service Agency and are from a population of educators in Southwestern Michigan involved in a federal grant to implement videoconferencing. This study is reliant on the data generated as part of the grant process.

The participants in this study are delimited to those involved in the implementation in the 35 school buildings. These individuals include teachers, media specialists, and school support personnel.

Limitations of the Study

The single group pretest, posttest design is a limitation of the study because there is no control group and the external validity is suspect (I. Newman et al., 2006).

Significance of the Study

Schools struggle to implement videoconferencing and educators exhibit reluctance to utilize new technologies (Habash, 1998; McCartan, 2005; Wexler, 2003). Schools, due to this struggle, find that the investments made in new technology may be lost if the implementation is not sustained.

An examination of a specific case of implementation in southwest Michigan may identify factors that need to be overcome so that videoconferencing is embraced as a tool for the school community. This study provides insight to factors that contribute to the successful implementation of videoconferencing and what factors influence the concerns of educators as they use videoconferencing in the classroom. The findings of this study add to the body of knowledge regarding the implementation of curriculum videoconferencing and the factors that affect the level of concern of educators.

Assumptions

The essential assumption is that videoconferencing in schools can enhance learning and improve the skills of teachers. This technology provides another effective tool for educators to employ. Further, educators are reluctant to embrace new technology,

such as videoconferencing, to integrate into the curriculum. They have a number of concerns that stand in the way of effective implementation. As videoconferencing is a worthwhile endeavor for schools, the effort to address concerns provides a good return for the investment of time, effort, and resources.

Summary

The implementation of videoconferencing is a new technology that is often difficult to implement in a school setting. The difficulties often relate to various factors that inhibit the implementation if educators do not embrace or sustain the use of the technology. While schools are making significant investments in equipment, infrastructure, and personnel, these investments do not necessarily guarantee successful, sustained implementation. Barriers related to implementation factors may inhibit success and raise the level of concern of educators related to implementation. The challenge is to identify and describe successful implementation, address the factors that influence educators' level of concern, and to study the ways in which implementers ensure that the integration of videoconferencing in the school is sustained.

The remainder of this study includes the literature review and a discussion of the research methods, including a description of the population, identification of variables, a discussion of the data, identification of instruments used, and procedures utilized in the study. This is followed by research findings and recommendations based on the findings.

CHAPTER 2

LITERATURE REVIEW

Introduction

The implementation of videoconferencing in middle and elementary schools is the

focus of this study. This chapter examines the literature related to videoconferencing

technology, barriers that hinder the implementation of technology innovation, particularly

videoconferencing technology in education. The review will examine technology

implementation in general and videoconferencing implementation in particular. The use

of the Concerns-Based Adoption Model is also explored as it is, in many cases, a

systematic approach to understanding technology implementation.

Videoconferencing Technology

The literature examined here discusses the definition of videoconferencing as

applied education and its implementation. Examples of videoconferencing applications

are presented to further define videoconferencing in schools. The use of

videoconferencing as a delivery method for teacher training and professional

development is also explored.

Videoconferencing in Schools

Videoconferencing connects individuals in one location to individuals at a remote

location (Keefe, 2003). In other words, a videoconference allows two parties in separate

locations to be connected by a device that provides picture and sound (Hahn, 2008).

These are two-way, interactive connections via the Internet or dedicated telephone

circuits. These connections are live, allowing people to interact across space in a real-

time environment (D. Newman, 2008). The connections are capable of producing full-

sized images, with clear audio (Bartlett, 2007). In a classroom setting, teachers are said to

be "bringing the world to their classroom" (Nys, 2009, p. 50).

Early uses of videoconferencing can be found in medicine (Perrin, 1996) and

business (Halhed, 1995; Nadeau, 1995). The applications of videoconferencing in this

study relate to curriculum videoconferencing and the use of videoconferencing for

training and professional development. Curriculum videoconferencing, according to Lim

(2009), "is to bring a learning experience to the students" (p. 12). It is intended to

enhance student learning. This differs from another type of videoconference: shared

classes. Unlike shared class offerings that connect locations regularly, curriculum

videoconferencing is not an everyday occurrence (Lim, 2009). Rather, it is an occasional

experience to enhance learning. Lawson, Comber, Gage, and Cullum-Hanshaw (2010)

recognize curriculum enhancement as an effective use of videoconferencing. This may

include connections with zoos, museums, authors, topic experts, or connections with

other classrooms (Bogart, 2003; Keefe, 2003; Lim, 2009). Videoconferencing can be an

effective tool for teacher professional development (Fadale, 1999).

The professional development application of videoconferencing becomes a tool

for teacher learning. Lawson et al. (2010) suggest that videoconferencing provides new

ways to deliver learning. They state, "Videoconferencing is not confined to a single mode

of teaching. It provides an avenue for delivery of traditional pedagogies as well as for

exploring new ways of educating children and adults" (p. 307).

Videoconferencing in schools presents challenges in implementation as the technology, and its application, evolves. The challenges include the cost of the technology and connections, the quality of the equipment, and the classroom environment and procedures that create the learning experience.

While cost continues to be a challenge to many schools, the equipment and connections are becoming more within reach. Since the 1990s, the price for end points, the units in the classroom that provide the connections, have been reduced from $20,000 or more to $5,000 per end point (Peckham, 2001). Peckham (2001) also points out that more and more connections can be made with IP connections rather than the much more expensive ISDN connections.

The quality of equipment and the procedures to set up videoconferencing continues to improve (Bell & Unger, 2003; Bogart, 2003; DeZoysa, 2001; Kinginger, 1998). DeZoysa (2001) states that early videoconferencing systems were difficult to set up, operate, and maintain. Institutions are finding that many of these problems are less of a challenge.

There are a number of examples of successful implementation of videoconferencing related to curriculum (Cifuentes & Murphy, 1999; Keefe, 2003; Lee, 2009; Lim, 2009; Marek, 2008; Parrish, 2008; Pixlee, 2007). These experiences include virtual field trips, interacting with experts, class dialogs, and shared projects between classes (Anastasiades et al., 2010; Au Yong, 2010; Bogart, 2003; Falco, Barbanell, & Newman, 2004; Keefe, 2003; Lim, 2009; Piecka, 2008; Stainfield, Fisher, Ford, & Solem, 2000; Yost, 2001).

There are a number of examples of virtual field trips delivered through the application of videoconferencing. Bell and Unger (2003) provide a look at a middle-school application of videoconferencing in Cape Elizabeth, Maine. The utilization of videoconferencing in that school included interactive sessions with other classes in the state and virtual field trips. In a Canadian study of field trips to art museums via videoconferencing, Sabatino (2008) examined the engagement of the secondary-school students with the museum environment. Sabatino's study involved four groups in a high-school art class visiting a distant art museum.

Videoconferencing programs can use the technology to connect the curriculum in a number of ways and are not limited to just field trips, classroom-to-classroom connections, or any other single application. A study by Keefe (2003) investigates the integration of videoconferencing in the elementary school. In Keefe's application, the school utilized a single study and broadcasted to individual classrooms. The study was also used to provide interactive videoconferencing experiences for students. These experiences included interactions with remote experts, interaction with other student groups, and virtual field trips. His results indicated that the curriculum was enriched through the application of videoconferencing. Videoconferencing can be used to assist student learning and to supplement classroom activities. Pixlee (2007) examined the use of videoconferencing as a delivery method for tutoring low-achieving students in middle and high schools and found videoconferencing to provide a high-quality experience for students.

Connections among classrooms are another primary application of curriculum videoconferencing. These connections may be between nearby schools or offer

interaction with students at a considerable distance that may connect different cultures and nationalities. A study by Kinginger (1998) provides an example of students interacting between countries. In this application, students took part in an international event between the United States and France. American students were able to practice French language skills, and French students were able to practice English skills by dialogue among the students. Kinginger (1998) reports that videoconferencing was a viable teaching tool in this project. Parrish (2008) reports a university/K-12 partnership involving the implementation of videoconferencing related to the dance arts. In this instance, videoconferencing was used to deliver instruction to elementary and middle-school students in Eloy, Arizona. Curriculum videoconferencing can be employed with young children. Piecka (2008) examined children's inquiry and dialogue in kindergarten class interacting as the children interacted with another class using videoconferencing. In contrast, it can be noted that videoconferencing can be used in higher education. Glass (2007) reports a case of implementation at the college level. In this instance, sociology students, as part of a course capstone experience, utilized videoconferencing as a method to interact with authors and scholars in the students' area of interest.

Examples of classroom-to-classroom videoconferencing provide a variety of applications related to cultural education. Anastasiades et al. (2010) reported an implementation between two elementary schools in Athens and Crete in which 46 students and 4 teachers shared activities around the topic of climate change. Cifuentes and Murphy (1999) investigated an exchange between classes in Mexico City, Mexico, and College Station, Texas. Students shared discussion of differences in culture and created and shared poems as a medium to enhance learning. Schools in Finland, Greece,

Norway, Sweden, and the United States created a cultural exchange shared in a study by Mizell (1999). Students were able to better understand other cultures and interact directly with students from other countries. Marek (2008) cites an example of cultural interaction in the teaching of English in Taiwan. He used videoconferencing as a tool to connect students in Taiwan to discussions on American holidays, characteristics of rural America, the park system, and other cultural topics. Lee (2009) cited a successful videoconferencing in language class in middle and high schools in Korea.

These examples provide insight to the possibilities to utilize videoconferencing to enhance the curriculum. A variety of approaches have been employed reflected in examples that include virtual field trips (Bell & Unger, 2003), tutoring (Pixlee, 2007), interaction with distant classes (Piecka, 2008), and cross-cultural interactions (Cifuentes & Murphy, 1999; Kinginger, 1998; Lee, 2009; Marek, 2008; Mizell, 1999). Videoconferencing provides a tool that leads to a variety of approaches that enhance the classroom curriculum.

<p style="text-align:center">Videoconferencing as a Tool for Professional Development</p>

Videoconferencing can be employed as a tool to facilitate professional development (Beninghof, 1996; Fadale, 1999; Hayden & Hanor, 2002; Hollingsworth, 2008; Horsley & Loucks-Horsley, 1998; Kullman & King, 2007; Pringle, Klosterman, Milton-Brkich, & Hayes, 2010; Roberts-Gray, Rood, Preston, & Hemenway, 2010; Townes & Caton, 2003). This type of professional development has been used in the health field for some time (Weber & Lawlor, 1998). Professional development through the use of videoconferencing has increased in schools as demonstrated by the implementation by the Berrien Regional Education Service Agency (2009).

Annetta and Dickerson (2006) present a case for the effective use of videoconferencing for teachers. Their study involves a 3-day professional development workshop for elementary science teachers. The use of videoconferencing enhanced access for teachers in rural areas. The authors report that the teachers experienced a similar training on site in an earlier workshop and found the virtual workshop equally effective. Bogart (2003) states that teachers can provide training from specialists in remote locations on topics important to the teaching staff. These interactions may not be otherwise available. She also found that staff within the district can also interact via videoconferencing, which results in less travel time and expense. Hollingsworth (2008) provides an example of utilizing videoconferencing to deliver professional development at a distance. Teachers were provided mentors to provide expertise in second-language instruction to 11 classrooms in rural Canada. Roberts-Gray et al. (2010) reported on the *Texas Connection*, a project that provided teacher workshops to schools in Texas from the McDonald Observatory. Pringle et al. (2010) utilized videoconferencing in what the authors refer to as "collaborative distance learning" (p. 54), delivering sustained professional development in science to teachers in two distant school districts. In the Pringle et al.'s opinion, based on their experience, videoconferencing is useful as a tool to deliver professional development.

In summary, videoconferencing provides a tool to enhance the curriculum and to assist in the facilitation of professional development. Since videoconferencing provides live, interactive two-way connections (D. Newman, 2008), students or staff can be connected to others literally anywhere in the world. The technology allows connections using traditional methods of instruction as well as new ways of educating students and

staff (Lawson et al., 2010). Videoconferencing allows connections to educational

opportunities that are otherwise not available to the school because of time constraints,

cost, or location.

Perceived Barriers in the Implementation of Videoconferencing

Much of the literature related to barriers in using videoconferencing can be placed

into four categories. These categories include: (a) equipment and technical support issues,

(b) professional development and training issues, (c) concerns with time, and (d) fear of

technology use. While the literature often sites multiple concerns as evidenced by

Westergaard (1999), Giuliani (2001), Pachnowski (2002), Brzycki and Dudt (2005), de la

Garza (2006), Masalela (2006), and Sandholtz et al. (1997), these four categories,

illustrated in Figure 2, capture the major theme regarding barriers to the use of

technology (Lundgren, 2008).
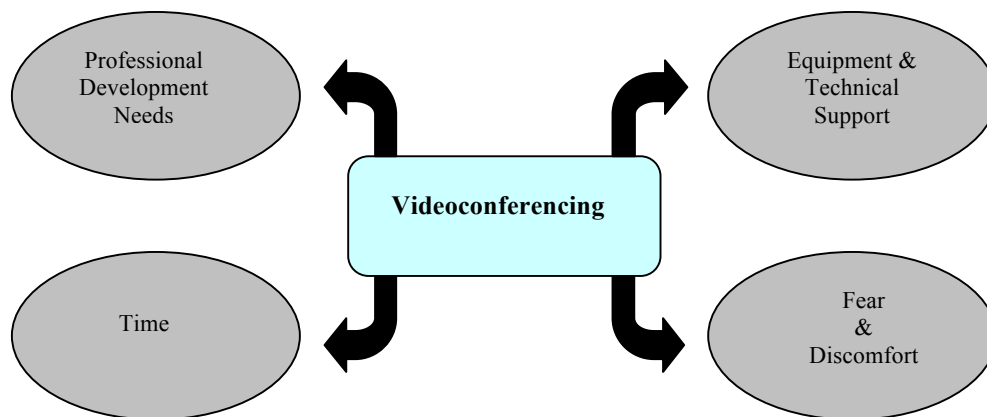
Figure 2. Barriers to implementing videoconferencing. From "Perceived Barriers to the
Adoption of Videoconferencing as a Tool for Distance Learning," by D. D. Lundgren,
2008, in N. A. Labanov & V. N. Skvortsov (Eds.), *Lifelong Learning Theory and
Practice of Continuous Education: Vol. 2. Proceedings of International Cooperation* (pp.
273-277), St. Petersburg, Russia: Alter Ego. Copyright 2008 by Alter Ego.

Equipment and Technical Support Issues

Problems related to equipment and technical issues appear to be one of the

primary barriers in the use of videoconferencing and other technologies (DeZoysa, 2001;

Giuliani, 2001; Malinski, 2000; Masalela, 2006; McDavid, 2003; Sandholtz et al., 1997;

Spooner, Knight, & Lo, 2007). Masalela (2006) cites a lack of access that contributes to

an individual not adopting online learning technology. The instructor's lack of technical

competence is mentioned by McDavid (2003) and relates to the need for technical

support. Giuliani (2001) found that the lack of technical support was a factor for those

who did not embrace videoconferencing.

Barriers arise due to the dependability of the equipment. DeZoysa (2001) points

to negative experiences with equipment difficulties as an obstacle to successful

implementation. Spooner et al. (2007) in a study of professional development to special

education teachers in North Carolina, found loss of connections as a point of frustration

for users. As Malinski (2000) finds, poor technical infrastructures prevent the adoption of

technology. Carpenter (2004) points to technical issues as barriers in a study of distance

learning students in a virtual school. Pemberton, Cereijo, Tyler-Wood, and Rademacher

(2004) and Passmore (2007) state that firewalls are big obstacles for districts and

businesses. They also cite problems with other equipment such as microphones affecting

voice quality. De la Garza (2006) reports that problems with hardware, software, and

infrastructure are barriers to the use of videoconferencing.

Insufficient Training in the Use of Equipment

The lack of training in the use of technology is a barrier to successful

implementation (Al-Alwani, 2005; Baker, 2002; Cassell, 2005; Ehrmann, 1999; Knipe &

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Lee, 2002). In a study of videoconferencing instruction in Belfast, Knipe and Lee (2002) reported that inadequate training of facilitators at remote sites using videoconferencing lowered the level of learning. Al-Alwani (2005) studied the level of information technology implementation in science classrooms in a school district in Saudi Arabia. He found that as teachers received more training, they increased the use of technology.

Giuliani (2001) and Malinski (2000) identify the need for faculty training and workshops for successful videoconferencing programs. Cassell (2005), in a study that involved 72 teachers in Mississippi, identifies that technology knowledge is essential in the effective use of technology by educators. Baker (2002) examined teachers using videoconferencing participating in the Partners in Distance Learning Consortium in Pennsylvania, New York, and New Jersey. He states that there is a relationship to training before implementing videoconferencing and the success of the implementation. This is supported by Grimes (1999) in his work with graduate students. Further, the works of Kirst (2005), Madi (2005), and Baker (2002) suggest that professional development and training must be ongoing and provided over time. Calhoun (2002) found that the lack of professional development would inhibit teachers from using technology.

Fadale (1999), in his study involving teacher professional development, makes the case that a virtual network that includes videoconferencing can itself serve as a professional development tool. He recommends exploring professional development projects to promote more participation in virtual networks.

Atchade (2002) suggests, and Westergaard (1999) supports, that a system of peer mentors can provide a system of embedded professional development. This is consistent with Madi's (2005) suggestion that professional support includes team meetings.

There is some concern that there may be lack of social interaction of participants in a distance setting using videoconferencing in contrast to a professional development experience in a single, face-to-face location. However, according to Moody and Wieland (2010), videoconferencing as a tool for professional development can provide for social interaction and "can be a valuable social presence tool" (p. 20). In a case study of interactions between college professors and students in a setting with local classrooms and multiple distance sites, Bohnstedt (2011) found that "no clear difference existed in instructor interaction with local and remote populations" (p. 198). She goes on to say that the remote participants interacted more frequently than those that were local.

<center>Time Concerns</center>

Time, that is, lack of time, is often cited as a barrier to the implementation of technology including videoconferencing (de la Garza, 2006; Dove, 2006; Haber, 2005; Masalela, 2006; Pachnowski, 2002; Peck, Cuban, & Kirkpatrick, 2002; Sandholtz et al., 1997). The issues of time are divided into two concerns. One is the concern regarding time to learn the technology. This concern is shared in a study of the Apple Classrooms of Tomorrow Project as teachers, when asked what they need in support to implement technology, responded that they needed time (Sandholtz et al., 1997). Dove (2006), in a study of 39 graduate students, found that the most frequently cited barrier was the time-consuming nature of online learning. Participants in a study by Masalela (2006) voiced concerns about the lack of time to learn and integrate technology. The second issue involves time to integrate videoconferencing and other technologies into practice. Peck et al. (2002), in a study of technology implementation in Northern California in 1998 and 1999, cited time constraints that prevent teachers from implementing technology and that

kept teachers from fully embracing the technology. Haber (2005) found this to be the greatest barrier for faculty in a community college environment. De la Garza (2006) and Pachnowski (2002) identify lack of time and difficulty scheduling as factors that prevent the integration of videoconferencing as a classroom tool.

Fear of Technology Use

The barrier related to fear manifests itself in several ways. These fears become obstacles to implementation and add to the concerns of those using the technology. As cited by Westergaard (1999), there is the fear of using technology that will not work or be dependable. More evident is a fear identified by McCartan (2005), Wexler (2003), Habash (1998), and van der Kaay (2007) as being personal in nature. These fears include discomfort with change, personal concerns, and lack of satisfaction using the technology. In a study of university faculty, van der Kaay (2007) found that older faculty surveyed indicated that technology is a source of stress.

Binner (1998) identified the fear of being on camera as a barrier to the use of videoconferencing. Finally, Minaya (2005) identifies fear and concern that technology will displace jobs and not be effective.

The literature points to four categories of barriers to embracing videoconferencing and related technologies. They are: (a) equipment and technical support issues, (b) professional development and training issues, (c) concerns with time, and (d) fear of technology use. The literature also suggests that an individual may experience barriers in multiple categories. These barriers create concerns for educators as they implement videoconferencing technology and may add to the fear cited in the four categories.

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Concerns-Based Adoption Model

The Concerns-Based Adoption Model was developed in the 1970s by the Research and Development Center for Teacher Education at the University of Texas (Newlove & Hall, 1998). In earlier work related to teacher concerns, Fuller (1969) at the University of Texas began describing teacher concerns in a study of teachers at three levels. This discussion by Fuller provides insight to the development of CBAM. The three levels include pre-teaching non-concern, overt concerns, and late concerns. At the pre-teaching level, the teacher is unaware that there may be a basis for concern. The innovation is not part of the teacher's knowledge or awareness. Overt concerns have to do with the teacher's concerns about adequacy. That is, the teacher realizes lack of knowledge and limitations in implementing the innovation. Late concerns are those concerns related to students and the learning the student will gain as a result of the teacher's work to implement the innovation.

This work regarding concerns was continued at the University of Texas resulting in the development of the Concerns Based Adoption Model. The model measures the concern level of individuals in relation to an innovation and provides a process for the adoption of the innovation (Hall et al., 1973). An underlying assumption of CBAM is that "in educational institutions change is a *process*, not an event" (Hall & Loucks, 1978, p. 37).

CBAM is intended to provide a process, a comprehensive approach to implementing change with attention given to the concerns of individuals in relation to an innovation in order to facilitate the change process. The model includes four components: Innovation Configurations, Stages of Concern, Levels of Use, and Intervention

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Taxonomy. The model is based on the connection between the educational innovation and the concerns of those involved in the implementation of the innovation.

The Stages of Concern questionnaire is used to measure the level of concern of individuals. This provides a diagnostic tool to prescribe staff development tactics. The works of Hall and others (Hall & Loucks, 1978; Hall et al., 1973) describe seven levels of concern. The first stage is *awareness*. The individual may by unaware of the innovation and have little concern. The second stage is *informational*. The individual may have limited knowledge of the innovation and have a low level of concern in relation to the innovation. Each stage that follows—*personal*, *management*, *consequence*, *collaboration*, and *refocusing*—indicates rising levels on knowledge, application, and impact.

The Stages of Concern questionnaire (SoC) from the Concerns-Based Adoption Model is often applied to technology implementation. Burns and Reid (1998) share that the SoC is a valuable tool to allowing them to identify and monitor staff concerns. This allowed them to better address these concerns. Holloway (2003) found that assessing teachers' level of concern aids innovation implementation.

There are examples of studies utilizing only the Stages of Concern questionnaire to assess the level of concern of participants and the modification of the SoC to fit the researcher's application (Christou et al., 2004; Davis & Roblyer, 2005; Gershner & Snider, 2001). Hall et al. (1973) described the application of the Stages of Concern questionnaire in such a way as to personalize staff development. The use of the questionnaire provides a teacher-centered diagnostic and prescriptive approach to staff development. This allows staff developers to gage the teacher's level in the change process expressed by the level of concern. Hall and Loucks (1978) suggest that the Stages

of Concern questionnaire provides a diagnostic tool for staff developers to personalize the change process to address the concerns of staff. A strength of the model is its flexibility to adapt to a variety of studies (Slough & Chamblee, 2007).

The Stages of Concern questionnaire was employed to assess the concerns of teachers receiving training in technology in a study by Davis and Roblyer (2005). In this study, the authors modified the Stages of Concern instrument to match the goals of the research. Questions in the instrument were written to match the technology application. A preservice teacher technology mentoring program was assessed using the Stages of Concern questionnaire in a study by Ward, West, and Isaak (2002). This application employed a pretest and posttest measuring the teacher's level of concern. In a study looking at the use of the Internet as an instructional tool, investigators Gershner and Snider (2001) utilized the Stages of Concern questionnaire from the Concerns-Based Adoption Model to evaluate the training of 49 middle- and high-school teachers in Texas. They employed the Stages of Concern questionnaire as a pretest and posttest in their research. CBAM has been employed in cases other than technology implementation. As an example, a project by Christou et al. (2004) applied the Stages of Concern questionnaire to assess the level of concern of teachers regarding the adoption of a new mathematics curriculum. The authors found this to be an effective tool to assist in the implementation of the new curriculum.

Innovation Issues Related to Technology Implementation

Owston (2007) views pedagogical innovation as requiring essential and contributing elements to implement and sustain an innovation. These elements contribute to the pedagogical change in not only the implementation of technology but other

innovations as well. These elements are illustrated in Owston's model for sustainability of classroom innovation. These essential conditions include teacher support, student support, administrative support, perceived value of the innovation, and professional development (see Figure 3).
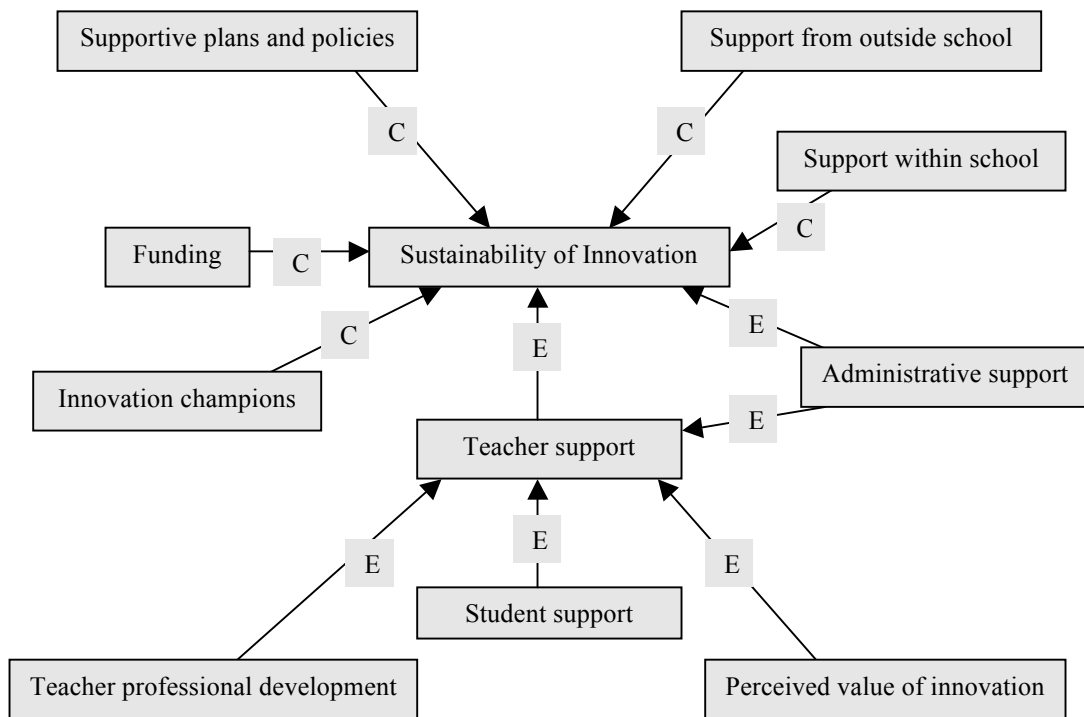
Figure 3. Owston's model for sustainability of classroom innovation. E indicates essential elements and C indicates contributing elements. From "Contextual Factors That Sustain Innovative Pedagogical Practice Using Technology: An International Study," by R. Owston, 2007, *Journal of Educational Change, 8*, p. 68. Copyright 2007 by Springer Science+Business Media.

Contributing elements in Owston's model involve a number of factors, among them are human and physical resources including funding, and support from outside the school and within the school, an individual whom Owston calls innovation *champion*.

Funding and support resources include infrastructure, equipment, technical support, and the budget for the innovation.

Ely (1990) lists eight conditions that facilitate the implementation of educational technology innovation. His conditions include: dissatisfaction with the status quo exists, knowledge and skills exist, resources are available, time is available, rewards of incentives exist for participants, participation is expected and encouraged, commitment is evident by those who are involved, and leadership is evident. The creation of these conditions was based on interviews with a number of educational technologists worldwide. Ely suggests that these conditions be considered at the planning stages of technology innovation.

This section is a discussion of several of these conditions and elements, and others, appropriate for this study. These conditions include Owston's essential elements: funding and resources. Embedded in this section is also an exploration of Ely's conditions of resources and leadership. Time for innovation implementation will be reviewed later in this chapter. These conditions and elements are included in this review as they are most applicable to this study.

<center>Teacher Support and Acceptance</center>

Teacher support is an essential factor in the acceptance, implementation, and sustainability of an innovation (Aust, Newberry, O'Brien, & Thomas, 2005; Kamal, Weerakkody, & Irani, 2011; Owston, 2007; Sherry, Billig, Tavalin, & Gibson, 2000; Straub, 2009). Teacher support includes a willingness on the teacher's part to take on an innovation with a commitment to the innovation. This speaks, too, to a level of acceptance by the teacher. This support and acceptance is tied to the sustainability of the

innovations.

Owston (2007) states: "Most fundamental to sustaining an innovation is teachers' support, for without this, the innovation simply cannot occur" (p. 69). Owston shares that once a teacher is committed to an innovation, the teacher will overcome shortcomings such as limited resources. He goes on to say that in all the cases of innovation he has studied, teacher support was always key to sustaining the innovation.

In 2001 and 2002, the Anchorage School District began a program to implement a standards-based curriculum. The district reviewed its progress using the Concerns Based Adoption Model. Fenton (2002) authored a report of the initiative. One of the conclusions was that in order to implement the curriculum, the teachers needed more information, training, and evidence that the project had value. It was recognized that teacher support would be necessary to implement and sustain the effort.

In a higher education study, a teacher education faculty was faced with the inclusion of a technology component in a teacher preparation curriculum (Aust et al., 2005). In order for this to take place, it was important that the faculty be ready for the change. Faculty support was necessary to move on to adoption of the technology to be included in the curriculum.

Rogers (1995) supports the premise that adopter support is needed to sustain innovation in his discussion of diffusion theory. Diffusion theory suggests that an innovation is communicated throughout the social system creating change. For this to be successful, adopters must find value in the innovation. The innovation must have promise that it will be of more value compared to the current state. This theory was studied in a technology and telecommunications setting in which teachers were involved in a project

to integrate the use of the Internet into the classroom (Sherry et al., 2000). Before the innovation could be integrated, teachers were supported by the administration, trained, and then became adopters as they embraced the value of the project. In another higher education study, Mitchell and Geva-May (2009) examined the relationship of faculty perceptions and the acceptance of online learning in a university setting. They found that reluctance to support online learning resulted in difficulty in adoption.

A study by Holland (2001) looked at teacher professional development and describes developmental levels in technology: nonreadiness, survival, mastery, impact, and innovation. Each of these levels included an element of teacher support and acceptance that affects the level of implementation and sustainability. The more the teachers move along this progression, the more they accept the change.

In a multiple case study by Kamal et al. (2011), the authors examined technology integration through the lens of stakeholders in the adoption of information technology systems government agencies. They suggest a systematic process to involve stakeholders and tap their views and expertise. The authors suggest that those responsible for implementing technology can make better decisions by taking into account the input of stakeholders. They state, "Developing a good understanding of the key stakeholders and their role in the adoption lifecycle will contribute to better decision making and a smoother implementation and adoption" (p. 209).

Administrator Support for Innovation

Fullan (2005), in his book *Leadership Sustainability System Thinkers in Action*, states that, in regard to reform, "leadership at the school and district levels was identified as crucial to success" (p. 3). Within the literature, a number of authors point to school

leadership as key to reform and innovation (Chen, 2008; Clarke, 2000; Dawson & Rakes, 2003; Fullan, 2010; Owston, 2007; Thomas, 2010). Owston (2007), in his model of sustainability of classroom innovation related to technology, shares a position that administrative support is an essential condition in supporting teachers and sustaining innovation. Further, supportive principals create conditions for innovation to grow and take hold. Those principals who are visionary and actively promote an innovation will often provide a direct leadership role in encouraging staff to integrate the innovation into daily activity.

Dawson and Rakes (2003) suggest that technology leadership promotes the use of technology in schools. They share that "as principals become more adept at guiding technology integration, more efficient and effective technology use should become prevalent in schools" (p. 43). In a study of the role of an instructional leader in the technology implementation, Thomas (2010) found that the principal can communicate a vision of technology integration and create an expectation of technology integration in the curriculum. In a study of educational leaders' technology preparation, experiences, and roles, Schrum, Galizio, and Ledesma (2011) found that leaders recognized that their role as knowledgeable technology role models was important in teachers embracing technology. They go on to say that administrators "see the use and support of technology as being important to their ability to effectively lead schools today" (p. 257).

Administrative support is critical as well in the implementation of innovation specifically related to technology (Currie, 2007; Ely, 1990; Keefe, 2003; Lei & Morrow, 2010; Lim, 2009; Nuckols, 2008; Rouch, 2008, Sandholtz et al., 1997). Ely (1990) interviewed leaders in instructional technology from North America, Latin America, and

Southeast Asia. These interviews included at least 25 individuals in each of several countries. His findings resulted in eight conditions that facilitate technology adoption. These conditions include dissatisfaction with the status quo, knowledge and skills exist, resources are available, time is available, rewards or incentives exist for participants, participation is expected and encouraged, commitment is exhibited by those who are involved and, finally, leadership is evident. Several of these conditions are related to leadership—resources, available time, rewards and incentives, expectations and encouragement, and, of course, leadership itself. He concludes that leadership that encompasses these conditions is necessary for the executive officer at the institutional level and also the leader involved with day-to-day operation. In another study based on interviews of technology directors, Nuckols (2008) also found administrative support to be key for technology adoption. Rouch (2008), in a study of support mechanisms for technology implementation, states that the support from the principal impacts the level of technology integration.

In a study that explored the effectiveness of a project to motivate teachers in a community college setting to integrate technology innovation into teaching practice, Lei and Morrow (2010) found several strategies that were essential to success. Their study applies surveys and interviews related to a specific technology project centered around Web and phone conferencing, virtual classrooms, online seminars, and other online events. The results were expressed in strategies that work. Among those strategies is strong leadership that provides motivation and ongoing support.

In a study of the integration of videoconferencing in an elementary school, Keefe (2003) analyzed a number of factors for successful implementation. He recognized the

value of administrative ongoing support and initiatives that encourage videoconferencing use. In this case, the administration modeled videoconferencing use in curriculum meetings and interaction with outside groups. In another study of videoconferencing application, Currie (2007) studied K-12 school districts in three Michigan intermediate school districts that utilized videoconferencing in the classroom. Michigan is divided into 57 regional areas, providing educational services to individual school districts, charter schools, and private schools. In many cases, videoconferencing is supported at the intermediate school district level. The purpose of Currie's study was to discover the status of videoconferencing in Michigan K-12 schools. In his findings, Currie noted that support from administration is among the keys to plan successful videoconferencing programs. Lim (2009) examined videoconferencing implementation and the role of videoconferencing coordinators. This examination included a look at school administration through survey instrumentation completed by practicing coordinators and others. Lim observed, in her study of videoconferencing coordinators, that "while the coordinator is important to the success of videoconferencing, the data suggest that the teacher attitudes and principal support play a greater role in the successful use of videoconferencing" (p. 130).

<center>Student Support</center>

Owston (2007) observes that the role of students in the acceptance of a technological innovation is often overlooked. His research of Thai secondary students suggests that with the introduction of technology, students are more eager to learn and want to attend class. He also notes that student enthusiasm provides teachers with motivation to implement the innovation. In a study on the attitudes of students in an

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online learning environment, Drennan, Kennedy, and Pisarski (2005) found that students'

positive perceptions of online learning resulted in a high level of satisfaction with the

technology. Cunningham (2009) investigated undergraduate students' perceptions of

experiences in coursework via videoconferencing. In this case, student perceptions were

quite positive. Similarly, Stone (2006) found a high level of satisfaction with courses via

videoconferencing among graduate students enrolled in counselor education courses at

Virginia Polytechnic Institute and State University.

<center>Funding and Resources</center>

Hargreaves (2002), in examining educational change, points to adequate resources

as a key characteristic of sustainable change including the introduction of new

technology. Resources, in this case, include equipment and infrastructure, human

resources for training and support, and sustainable funding. Adequate resources are

evident in the literature as an element for technology integration (Alberta Education,

2010; Ely, 1999; Harvey-Buschel, 2009; Nuckols, 2008; U. S. Department of Education,

2010).

In a publication outlining the elements of instituting a one-to-one computer

initiative, Alberta Education (2010) includes sufficient equipment and infrastructure as

essential components in learning with technology. Harvey-Buschel (2009) found that the

number of computers available in a mathematics classroom had an impact on the level of

technology integration. Teachers with more computers in their classroom integrated

technology more often in instruction. Ely (1999) states that tools and software must be

available to make an innovation work.

The necessary infrastructure not only includes elements in a local school district

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but also on a larger scale. The U. S. Department of Education (2010), in its 2010 National

Education Technology Plan, states:

> Although we have adopted technology in many aspects of education today, a comprehensive infrastructure for learning is necessary to move us beyond the traditional model of educators and students in classrooms to a learning model that brings together teaching teams and students in classrooms, labs, libraries, museums, workplaces, and homes—anywhere in the world where people have access devices and an adequate Internet connection. An infrastructure for learning is necessary to support a learning society in which learning is lifelong and lifewide. (p. 51)

The plan does regard as essential all areas of infrastructure including broadband

connections, equipment, software, and personnel.

Resources include funding for equipment, infrastructure, and programming.

Owston (2007) identifies funding as a contributing factor for the sustainability of

innovation in his model for sustainability of classroom innovation. Nuckols (2008) found

in a study of technology directors that sufficient funding and budgeting were crucial to

the adoption of technology. This funding not only includes start-up costs but also the on-

going budget demands of maintaining technology and continuous professional

development. Constable (2003) identifies sufficient funding as part of a successful and

sustainable school technology program.

<div align="center">Professional Development</div>

Professional development is a vital component to successful technology

integration (Alberta Education, 2010; Anderson, 2008; Cuban, 2001; Currie, 2007; Davis,

Preston, & Sahin, 2009; Ehrmann, 1999; Higgins & Spitulnik, 2008; Marinho, 2003;

Meier, 2005; Oates, 2002; Sandholtz et al., 1997; Zhao, Pugh, Sheldon, & Byers, 2002).

Ehrmann (1999) recognized the need for faculty development in the technology

revolution in higher education. According to Oates (2002) there is a "growing awareness

of professional development's vital place in the successful integration of technology into education" (p. 12). A study by Keller, Hixon, Bonk, and Ehman (2008) indicated that teachers identified professional development as a top influence in using technology in the classroom. In a study related to videoconferencing, Bose (2007) asserts that a high level of professional development resulted in a greater use of videoconferencing. Anderson (2008) conducted a study of videoconferencing applications in five Alberta school divisions in Western Canada. He found that the use of videoconferencing is effective for the delivery of professional development.

Experience related to the Apple Classrooms of Tomorrow project (Apple Computer, 1990) suggests that teachers need to be prepared to use technology effectively and time is needed to develop skills. Apple Computer, from 1985 through 1990, provided computers to students and teachers at five public school sites. This included 35 elementary and secondary teachers. The findings for the 5-year report shared that teachers experienced three stages throughout the 5 years. The first stage was *survival*. In this stage, teachers were not able to anticipate problems, including student misbehavior, changes in the physical environment, technical problems, and changes in classroom dynamics. The second stage, *mastery*, saw teachers begin to develop strategies to solve problems. In the third stage, *impact*, teachers used technology to their advantage in managing the classroom. The report's findings concluded that innovation takes time and teachers need to move through these stages in order to take full advantage of the technology. While willingness to tackle the innovation may be apparent, the report shares that "when classrooms are drastically altered and teachers are willingly immersed, change is slow, and sometimes includes temporary regression" (p. 7). Teachers can learn

important lessons from the insights of previous implementation projects such as Apple Classrooms of Tomorrow.

A variety of factors contribute to successful acceptance and integration of technology into teaching and learning. Keller et al. (2008) examined teachers in rural Indiana involved in an initiative called Teacher Institute for Curriculum Knowledge about Integration of Technology. Findings indicated that professional development activities were the second most important factor in technology integration after the teacher's personal interest in technology. Professional development emerges as a leading factor in successful technology implementation efforts.

An effective strategy for schools to deliver effective professional development is to engage in partnerships with various entities. In the late 1990s, the Intel Teach to the Future initiative targeted 100,000 teachers to receive training in technology use demonstrating a partnership with industry and education. This program targeted teachers nationwide especially in high poverty regions. Martin, Culp, Gersick, and Nudell (2003) in a study of the Intel program found that professional development impacted classroom practice and that teachers were very positive in regard to their training and newfound skills. In another partnership example, a collaborative professional development model reported by Franklin and Sessoms (2005) examined an initiative in which a faculty from a college of education partnered with a local school district. This partnership was a yearlong effort to integrate technology at a high level. This study—as well as studies by Lloyd and McRobbie (2005) and Hughes, Kerr, and Ooms (2005)—also suggested that technology professional development is effective when it is delivered within the context of classroom activities, allowing teachers to make direct application of skills learned.

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In a multiple-case study by Marinho (2003), 10 faculty members in a Midwestern university participated in training and workshops in instructional technology. He found that the quality of professional development influenced the experience of faculty learning instructional technology. The participants shared that active learning in a hands-on environment provided the most effective professional development. The practice and time resulted in improved implementation.

A number of professional development activities include the use of mentors. Mentors may be found within the school or school district. In some cases, they may be local trainers who may form a support system (Keller et al., 2008; Mouza, 2002). Peer coaching presents another form of mentoring. Holland (2001) contends that peer coaching is an excellent way for teachers to reach mastery and to apply what they learn to classroom practice. Oates (2002) looked at the approach to technology development at New Trier High School District in suburban Chicago. She found mentoring to be "a key element of a staff development initiative for technology literacy and integration" (p. 13).

Keller et al. (2008) further examined mentoring in terms of teachers finding assistance with technology integration issues by utilizing others in their buildings with the ability to provide help. They found that 76.2% of the teachers in the study identified the technology coordinator as someone able to assist them and 62.9% identified another classroom teacher.

Another example of effective professional development includes the use of peer groups or professional learning communities (Mouza, 2002; Oates, 2002). This also extends to team building as explored in a study by Mulqueen (2001). Hughes and Ooms (2004) examined the application of professional development through the use of inquiry

groups in an urban setting. This activity involved small groups studying the application of technology. They found this to be an effective approach well accepted by the participants. Higgins and Spitulnik (2008) identified effective professional development in the form of collaborative learning groups working to integrate technology into science classrooms.

This section reviewed those topics related to the implementation of a technology innovation that included, in a few instances, the implementation of videoconferencing. The next section will explore videoconferencing technology and its implementation.

Summary

This chapter has explored the literature related to the study of the implementation and sustainability of a technology innovation with attention given to videoconferencing implementation. The review discussed a number of elements and conditions related to implementation including definitions of videoconferencing, applications of videoconferencing in the school curriculum, and videoconferencing as a tool for professional development, and identified the significant barriers in implementing videoconferencing. Key discussion points for this study were specifically professional development, time, and technology support.

The literature demonstrated that videoconferencing is a tool that can be used to enhance the curriculum (Lawson et al., 2010; Lim, 2009) and facilitate training and professional development (Fadale, 1999). At the same time, there are barriers that present challenges to the implementation of videoconferencing (Lundgren, 2008). Among these barriers is the fear and discomfort that educators experience that raise individual concerns as they implement the technology.

Owston (2007) provides a Model for Sustainability of Classroom Innovation that

identifies specific elements that contribute to successful and sustainable implementation. The literature shows that these elements are present in the implementation of videoconferencing technology.

CHAPTER 3

METHODOLOGY

Introduction

This chapter describes the methodology of the study. The research design and research questions are discussed along with a description of the population, variables, and data collection.

The purpose of this study was to determine what factors predict levels of implementation of videoconferencing by videoconferencing coordinators and classroom teachers. This study also addresses how the factors examined in predicting the level of implementation influence the level of concern of videoconferencing coordinators and classroom teachers. The research method applied in this study examined these factors and will examine implementation of the federal grant.

Research Design

This quantitative research used a single group pretest, posttest design study of an implementation of a federal grant awarded to the Berrien Regional Educational Service Agency in Michigan. In this study, the population is comprised of the participants in the 35 middle and elementary schools that received funding in the federal grant. The study compares a number of factors to determine the relationship among them.

Survey methods were applied to quantify levels of concern as well as several factors that will be discussed in this chapter. The design also utilized ordinal data that

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include count data for several factors, including the number of connections to indicate the level of implementation.

Statistical tests were applied to the data collected. Repeated measures of analysis were used to assess if there is a significant difference between pretest and multiple posttest Stages of Concern survey data. A canonical correlation analysis was applied to examine the relationships between a linear combination of the level of concern and number of connections and the linear combination of professional development hours, equipment reliability, building-level technical support, and district-level technical support. Finally, a hierarchical regression analysis tested the relationship (in addition to professional development hours, equipment reliability, building-level technical support, and district-level technical support) regarding to what extent the number of connections is related to the level of concern.

Description of the Population

The research population included 53 videoconferencing coordinators and other educators implementing videoconferencing in each building. The sample included the entire population in the case. The implementation of the Project required each school building to appoint a videoconferencing coordinator. The videoconferencing coordinator was an educator in a school building responsible for scheduling and managing two-way, interactive connections. The coordinator also provided leadership in the building in the implementation of videoconferencing. This role was a part-time duty. Depending on the building organization, the coordinator's primary roles varied. These primary roles included teacher, media specialist, or paraprofessional.

All participants took part in an initial one-day training at the beginning of the

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school year during the first year of participation in the grant. This training provided an overview of videoconferencing, expectations for participants, hands-on technical training using videoconferencing equipment, and training on how to support videoconferencing in the school building.

The overview of videoconferencing included several pieces of information. This included a brief history of videoconferencing and how it can be applied in classroom settings to enhance the curriculum. A videoconferencing unit was present in the room and participants were able to view the equipment and experience a demonstration. This included instruction on the operation of the equipment, including steps to make a connection and facilitate a conference. Specific examples of educational applications were shared such as connections to zoos, museums, and other classrooms.

Expectations were listed for participants regarding training, reporting, and connection requirements. Training expectations included the one-day training, one 30-minute building presentation, a practice connection with another school in the Project, and participation in at least one professional development session delivered by videoconferencing. The practice session with another school provided the participants an opportunity to practice connecting a session, running the equipment, and disconnecting the conference. The professional development session was an after-school activity conducted by the Berrien RESA Videoconferencing Coordinator with the content based on the needs of the participants. Participants were required to schedule and log each connection on a Berrien RESA online database. This provided connection data for the Project and allowed the Berrien RESA Implementation Team to monitor the use of the equipment. This information entered included the teacher's name, school building, date,

grade level or content area, videoconference title, and program provider. Each building was required to complete at least five program connections each year.

Hands-on training during the session allowed participants to physically operate the equipment to familiarize themselves with the controls. This activity included dialing a connection, adjusting the sound levels, moving the camera, and disconnecting the conference. The training included a discussion of the procedures to obtain technical support in the building from the videoconferencing coordinators, building or district technical support personnel, or the Berrien RESA Project Implementation team.

After the videoconferencing systems were installed in each building, a minimum 30-minute staff training was conducted at the building by the Berrien RESA Project Coordinator. This training involved a discussion on the curriculum applications of videoconferencing, a demonstration of the equipment, and general instruction on how to use the equipment. This was followed throughout the year with periodic mentoring and support delivered by the Berrien RESA Project coordinator and the building videoconferencing coordinator. This periodic mentoring was often delivered at the request of the building videoconferencing coordinator or a classroom teacher. The activities of the mentoring session ranged from troubleshooting equipment to assistance in participating in an actual connection. Participants also utilized peer mentoring to enhance their skills.

Some participants availed themselves of the opportunity to take optional courses on the integration of videoconferencing in the curriculum. Short courses, such as one-day workshops via videoconferencing presented programs related to curriculum videoconferences available from content providers. Long courses over several weeks

were delivered in face-to-face workshops and via videoconferencing. These courses included methods to partner with other classes outside the school building using videoconferencing as well as other uses of videoconferencing in the classroom.

In years 2 and 3 of the Project, each building participated in at least one professional development session provided via videoconferencing. Several sessions were offered in core curriculum or technology-related topics tied to the use of videoconferencing.

Videoconferencing coordinators were required to complete additional training. The videoconferencing coordinators were the primary contact in each building during the duration of the Project. Each videoconferencing coordinator participated in at least two courses designed to equip each coordinator with the skills necessary to complete the coordinator's role. Coordinators participated in periodic training as well as one-to-one support from the Berrien RESA Project coordinator. These individuals also mentored participants in the coordinator's building. In addition to training and professional development for the participants, the Project implementation team provided support throughout the Project via telephone, videoconferencing, and face-to-face meetings.

The research population included teachers who participated in the Project and utilized videoconferencing in the classroom. The participating teachers met training requirements. The requirements for classroom teachers were less rigorous than the requirements for the building videoconferencing coordinators.

Variables

This study was conducted with two dependent variables, the level of concern and the number of connections. These two dependent variables were measured against the

independent variables of equipment reliability, technical support at the building-level, technical support at the school district level, and the participation in training and professional development. Additionally, the relationship of the two dependent variables was considered.

Level of Concern

The level of concern is connected to the success and the sustainability of the activities and goals of the federal grant. This concern is related to fear experienced by individuals adopting a new technology. The level of concern is also a measure of the confidence the individual has to implement the technology. This fear has been identified by McCartan (2005), Wexler (2003), and Habash (1998) as being personal in nature. These fears include discomfort with change, personal concerns, and lack of satisfaction using the technology (Lundgren, 2008).

Number of Connections

The federal grant considered the variable number of connections as an indicator of success of the Project. The grantor was interested in this count data to be sure that the equipment and effort are engaged to meet the goals of the grant. In this case a connection took place when a videoconferencing unit in a building interacted with a unit in another location. The location varied; it might have been a connection to another school in the school district or a classroom halfway around the world. A connection took place in a few minutes or continued for the entire school day.

Equipment Reliability

The level of equipment reliability is a concern for those implementing

videoconferencing (de la Garza, 2006). This issue is related to software and hardware problems with the videoconferencing equipment that interfere with the success of videoconferencing connections. This reliability also may be affected by the quality of the Internet connection.

Building-Level Technology Support

As problems with connections arose, users may have required technology support at the building-level. This involved technical support related to the videoconferencing equipment or solving problems with the technology infrastructure in the building. Videoconferencing coordinators and teachers identify inadequate technology support as a barrier to implementation (Giuliani, 2001; Lundgren, 2008; McDavid, 2003). Examples of building-level issues include improper setup on the videoconferencing unit, repair of damaged cables, problems with internal network devices, and other issues unique to a specific building. These issues are often beyond the expertise of the videoconferencing coordinator and teacher, requiring a technology specialist to solve technical problems.

District-Level Technology Support

Just as building-level support is a concern of those implementing videoconferencing, the district-wide support is also a factor of concern. Again, technology specialists are needed to ensure that the equipment and software are maintained and functioning properly. Often, this equipment and connection to the Internet are not at the same site as the building.

Training and Professional Development

In a previous study the need for professional development was most often cited by

grant participants as a concern (Lundgren, 2008). Other studies have identified the need for professional development for successful implementation of technology (Baker, 2002; Giuliani, 2001; Malinski, 2000). In this case, training and professional development were provided through initial face-to-face presentations, workshops provided over the videoconferencing equipment, participation in online courses, and peer sharing sessions over videoconferencing.

Data Collection

Pre-existing data from the implementation of the federal grant provided all the data used in this study. The Berrien RESA staff implemented data-collection strategies from the inception of the Project in order to satisfy grant reporting requirements, to provide reports to the public and stakeholders, and to compile data to aid future grant application efforts and further study.

Level of Concern Data Collection

The level of concern was measured by using the Stages of Concern questionnaire based on the Concerns-Based Adoption Model, also known as CBAM. Although there are several components to this model, this study involves one part of the model, indicating each participant's stage of concern as shown in Appendix A.

The Stages of Concern questionnaire (SoC) from the Concerns-Based Adoption Model (CBAM) is often applied to technology implementation. The Concerns-Based Adoption Model was developed in the 1970s by the Research and Development Center for Teacher Education at the University of Texas (Newlove & Hall, 1998). In earlier work related to teacher concerns, Fuller (1969) at the University of Texas began describing teacher concerns in a study of teachers at three levels. This discussion by

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Fuller provides insight to the development of CBAM. The three levels include pre-teaching non-concern, overt concerns, and late concerns. At the pre-teaching level, the teacher is unaware that there may be a basis for concern. The innovation is not part of the teacher's knowledge or awareness. Overt concerns have to do with the teacher's concerns about adequacy. That is, the teacher realizes lack of knowledge and limitations in implementing the innovation. Late concerns are those concerns related to students and the learning the student will gain as a result of the teacher's work to implement the innovation.

This work regarding concerns was continued at the University of Texas, resulting in the development of the Concerns Based Adoption Model. The model measures the concern level of individuals in relation to an innovation and provides a process for the adoption of the innovation (Hall et al., 1973). An underlying assumption of CBAM is that "in educational institutions change is a *process*, not an event" (Hall & Loucks, 1978, p. 37).

CBAM is intended to provide a process, a comprehensive approach to implementing change with attention given to the concerns of individuals in relation to an innovation in order to facilitate the change process. The Stages of Concern questionnaire is used to measure the level of concern of individuals. This provides a diagnostic tool to prescribe staff development tactics. The work of Hall and others (Hall & Loucks, 1978; Hall et al., 1973) describes seven levels of concern.

The first stage is *awareness*. The individual may by unaware of the innovation and have little concern. The second stage is *informational*. The individual may have limited knowledge of the innovation and have a low level of concern in relation to the

innovation. Each stage that follows—*personal, management, consequence, collaboration,* and *refocusing*—indicates rising levels on knowledge, application, and impact.

Burns and Reid (1998) share that CBAM is a valuable tool to allowing them to identify and monitor staff concerns. This allowed them to better address these concerns. Holloway (2003) found that assessing teachers' level of concern aids innovation implementation.

There are examples of studies utilizing only the Stages of Concern questionnaire to assess the level of concern of participants (Davis & Roblyer, 2005; Gershner & Snider, 2001; Christou et al., 2004). Hall et al. (1973) described the application of the Stages of Concern questionnaire in such a way as to personalize staff development. The use of the questionnaire provides a teacher-centered diagnostic and prescriptive approach to staff development. This allows staff developers to gage the teacher's level in the change process expressed by the level of concern. Hall and Loucks (1978) suggest that the Stages of Concern questionnaire provides a diagnostic tool for staff developers to personalize the change process to address the concerns of staff. A strength of the model is its flexibility to adapt to a variety of studies (Slough & Chamblee, 2007).

The Stages of Concern questionnaire was employed to assess the concerns of teachers receiving training in technology in a study by Davis and Roblyer (2005). In this study, the authors modified the Stages of Concern instrument to match the goals of the research. Questions in the instrument were written to match the technology application. A preservice teacher technology mentoring program was assessed using the Stages of Concern questionnaire in a study by Ward, West, and Isaak (2002). This application employed a pretest and posttest measuring the teacher's level of concern. In a study

looking at the use of the Internet as an instructional tool, investigators Gershner and

Snider (2001) utilized the Stages of Concern questionnaire from the Concerns-Based

Adoption Model to evaluate the training of 49 middle- and high-school teachers in Texas.

They employed the Stages of Concern questionnaire as a pretest and posttest in their

research. CBAM has been employed in cases other than technology implementation. For

example, a project by Christou et al. (2004) applied the Stages of Concern questionnaire

to assess the level of concern of teachers regarding the adoption of a new mathematics

curriculum. The authors found this as an effective tool to assist in the implementation of

the new curriculum.

The Stages of Concern questionnaire used in this study was developed by the

Berrien RESA Project implementation team. Berrien RESA technology staff, including

myself, and the president of a contracted evaluation firm developed the specific Stages of

Concern questionnaire used in this study. The questions created specifically address the

implementation of videoconferencing.

The instrument asked participants to indicate their level or stage of concern based

on the following categories:

Stage 1: Awareness. I am aware that videoconferencing exists but have not used

it—perhaps I'm even avoiding it. I am anxious about the prospect of using

videoconferencing.

Stage 2: Learning the process. I am currently trying to learn the basics. I am

sometimes frustrated using videoconferencing. I lack confidence when using

videoconferencing technology.

Stage 3: Understanding and application of the process. I am beginning to

understand the process of using videoconferencing and can think of specific uses in which it might be helpful to me in my role.

Stage 4: Familiarity and confidence. I am gaining a sense of confidence in using the videoconferencing for specific purposes (e.g., instruction; professional development; meetings; communications; etc.). I am starting to feel comfortable using the videoconferencing technology.

Stage 5: Adaptation to other contexts. I think about the videoconferencing as a tool to help me and am no longer concerned about it as videoconferencing. I can use it in many applications and as an instructional aid.

Stage 6: Creative application to new contexts. I can apply what I know about videoconferencing in the classroom. I am able to use it as an instructional tool and integrate it into the curriculum.

The staff responsible for the Project purposely omitted what is often the first stage in the Stages of Concern questionnaire, *Unaware of the Technology*. In the process of writing the grant and submitting the application, all parties had some awareness of videoconferencing as these individuals were engaged in the grant submission and acceptance of the grant.

Videoconferencing coordinators and teachers responded to the survey as a pretest at the inception of the grant and before training. They responded again as a posttest at the end of the second and third years of the grant activities. While the majority of the participants joined grant activities in the first year of the grant, additional participants were added to the grant in the second year, creating two cohorts. The first cohort completed the pretest in September of 2005 and the second cohort completed the pretest

in September of 2006. Table 1 provides the schedule used for the administration of pre-
and posttests.

Table 1

Pretest and Posttest Schedule for Cohorts 1 and 2

Date/Test	Sept 05 Pretest 1	May 06 Posttest 1	Sept 06 Pretest 2	May 07 Posttest 2	May 08 Posttest 3
Cohort 1	X	X		X	X
Cohort 2			X	X (1st Posttest)	X (2nd Posttest)

Number of Connections

The number of connections was obtained from a Berrien RESA database of
annual usage for each building. The Berrien RESA Instructional Technology Department
logged all videoconferences including the building(s) and teacher(s) involved in each
connection.

The method to collect the data utilized a Web-based, online scheduling and
reporting database tool. This tool, developed by the Project coordinator, had been in use
for several years before the grant was awarded. The building videoconferencing
coordinator or the Project coordinator scheduled each event. This scheduling provided
input to the database.

The Project coordinator collected these count data for reporting purposes and to
monitor the utilization of each building. For several years the Berrien RESA Annual
Usage Reports were compiled at the end of each school year and were available online.
This practice continued in the course of the project.

For this study, the level of implementation is defined by the number of connections completed by the coordinator's school building.

Equipment Reliability Data Collection

The Berrien RESA coordinator of videoconferencing, along with the Berrien RESA technology staff, tracked any outages or equipment failures that occurred throughout the duration of the Project. These data included instances where the building experienced the failure. The report from the videoconferencing coordinator and technology staff is the source of this data point.

Building-Level Technology Support Data Collection

Videoconferencing coordinators worked directly with the district technical staff to implement videoconferencing. Building-level technical support included individuals within the building or school district specialists assigned to the building with responsibilities that included the technical aspects of videoconferencing. Private vendors specializing in technology support might have supplemented this work.

The data for this factor were in the form of the videoconferencing assessment of building-level technical support. These data were collected at the end of year 2. The 35 videoconferencing coordinators were asked to assess the level of technology support in the building. This consisted of two questions administered online at the time of the Stages of Concern posttest. The questions related to building-level technology support were developed by the Project implementation team.

District-Level Technology Support Data Collection

The technology support at the district level is another factor that was considered.

Videoconferencing connections flow through district-level networks and Internet and ISDN connections. Further, a school district may have several buildings involved in videoconferencing that must be coordinated and supported. Private vendors may in some cases supply district support.

Experts at the Berrien RESA assessed the level of district technology support based on the rubric in Appendix B. These experts include the Berrien RESA technology staff and members of the Project implementation team.

Training and Professional Development Data Collection

As part of the federal grant, videoconferencing coordinators and classroom teachers participated in various opportunities for training and professional development. Berrien RESA logged individual participation in these events for the duration of the Project.

Research Questions

The following research questions were formulated related to the factors examined in the study.

1. To what extent does program implementation impact levels of concern?

2. What is the nature of the relationship between a linear combination of level of concern and number of connections and the linear combination of professional development hours, equipment reliability, building-level technical support, and district-level technical support?

3. In addition to professional development hours, equipment reliability, building-level technical support, and district-level technical support, to what extent is the number of connections related to the level of concern?

Reliability

The Cronbach's Alpha was applied to estimate the reliability of the Stages of Concern questionnaire. Reliability was acceptable (α = .745). In addition, the first year of the testing was treated as a pilot and reviewed by the Project implementation team.

The Stages of Concern has been utilized in a number of studies related to the implementation of technology and teacher change. These include a study by Brzycki and Dudt (2005) related to barriers of technology implementation. Two studies, one by Beninghof (1996) and another by Horsley and Loucks-Horsley (1998), related their application of CBAM to providing staff development as a means to bring about teacher change. A study by Holloway (2003) examined aiding innovation by addressing teacher concerns.

The number of connections, the number of training professional development activities, and the equipment reliability are count data. These count data are reliable to the extent that the collection was monitored and confirmed by the Project implementation team. The count data and equipment reliability data were reviewed and confirmed by a program evaluation firm external to Berrien RESA.

The data related to district-level technology support were provided by experts within Berrien RESA. These technology experts have direct knowledge and experience with the district support that was in place in each district involved in the Project. The building-level technology support was reported by each building's videoconferencing coordinator and reviewed by the Project implementation team.

Validity

The application of the Stages of Concern questionnaire in previous studies were

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reviewed. The Project implementation team created the specific questions in the Stages of Concern questionnaire used in this study. In addition, technology experts examined the instrument to check validity. Other variables are count data that were reviewed by the Project implementation team and other technology experts in Berrien RESA. The validity of the count data was confirmed in internal and external reports.

Procedures

The Concerns Based Adoption Model was administered through a Web-based survey. This method allowed for convenient administration and was easily accessible to all participants. This allowed Project coordinators to easily access the database created from the survey to be sure all participants responded completely. The survey was administered as a pretest at the first training session for participants as each participant accessed the survey at the beginning of the session. The initial sessions took place at the beginning of the Project cycle in the fall of 2005 for Cohort 1 and in the fall of 2006 for Cohort 2. Participants took the survey as a posttest at the end of each Project year in the spring. This provided pretest and posttest data for analysis.

Web-based entries were made by the videoconferencing coordinators to provide count data regarding the number of connections for each building. These were reviewed and confirmed by the Project coordinator as all connections were arranged or monitored by the Project coordinators. The database created by the entries includes the duration of the connections; the type of connections indicating a student program, meeting, or professional development opportunity; teacher information such as name and Email address; grade level; program provider information; date; and technical connection details.

The Project coordinators tracked the reliability of equipment through observations of connections that could not be completed. The Project coordinators also tracked equipment failures related to Project activities.

The building-level technology support was based on feedback from all videoconferencing coordinators in each building. This was administered at the end of the second year of the Project.

The district-level technology support was assessed by the Berrien RESA technology staff. The Berrien RESA staff members worked closely with each district's technology issues related to the Project. In addition, the Berrien RESA technology staff also interacted with each district in all aspects of technology operation. These individuals provided expert input to a questionnaire to assess each district's level of technology support.

The grant award prescribed a regiment of training and professional development that was provided initially as face-to-face instruction. This was followed by online short courses ranging from a few hours to several days, online long courses that may meet up to 15 weeks, and peer-to-peer sharing sessions with multiple buildings through the videoconferencing equipment, and internal presentations at building-level staff meetings.

Data Analysis

Repeated measures of analysis were used to assess if there was a significant difference between pretest and multiple posttest Stages of Concern survey data, as there were repeated measures of the same variable (StatSoft, 2011). The method examines each posttest to provide analysis to every level of response based on repeating the posttest (Diekhoff, 1992). A paired *t*-test was also applied to determine if there was a significant

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difference between pretest and posttest data.

A canonical correlation analysis was applied to examine the relationships between a linear combination of the level of concern and number of connections and the linear combination of professional development hours, equipment reliability, building-level technical support, and district-level technical support. Canonical correlation analysis was used to analyze the relationships between two sets of variables (Tabachnick & Fidell, 2001). In this instance, the two dependent variables created one set and the independent variables made up the second set. Level of significance was set at the 0.05 level.

A hierarchical regression analysis tested—in addition to professional development hours, equipment reliability, building-level technical support, and district-level technical support—to what extent the number of connections was related to the level of concern. This method allows predictor variables to be added to the analysis in a predetermined sequence (Keith, 2006; Klein & Kozlowski, 2000) to test the significance of each variable.

Limitations

There is a threat in the reliability of the Stages of Concern questionnaire as it is tailored to the application of videoconferencing in this case. The threat exists as the instrument is focused to this specific case.

Summary

This chapter reviewed the methodology applied to this study. Presented were the variables in the study, the research population, the procedures that were used to gather data, and the plan for data analysis. The analysis applied included descriptive statistics, repeated measures of analysis, a paired t-test, canonical correlation, and a hierarchical

regression analysis. Results are described in detail in Chapter 4.

CHAPTER 4

RESULTS

Introduction

In February 2005, the Berrien Regional Education Service Agency in Michigan

received a $350,000 United States Department of Agriculture Rural Utilities Services

Distance Learning and Telemedicine Grant to implement videoconferencing capability

(from now on to be referred to as the Project) in 35 middle and elementary schools. The

purpose of this study was to examine the impact of this Project on the levels of concern

of a group of participants in Berrien County, Michigan. A more detailed description of

this Project was presented in Chapter 3. This chapter presents a description of the

participants and the results of the data analysis for each research question. Descriptive

statistics, one-way repeated measures of analysis of variance, canonical correlation

analysis, and multiple regression analysis are used. Level of significance is set at the

0.05 level.

Description of the Sample

The participants in the Project included 53 teachers, media specialists, technology

specialists, and paraprofessionals. The Project involved the operation of

videoconferencing equipment, staff training in the use of the equipment, and professional

development related to the use of videoconferencing in the curriculum in 10 middle

schools and 25 elementary schools. Data for one elementary school were incomplete and

that school was removed from the study, resulting in a total of 34 school buildings. Of the 53 participants, 75% were elementary educators and 26% were middle-school educators.

Analysis of the Research Questions

To what extent does program implementation impact levels of concern?

An examination of Concerns Based Adoption Model (CBAM) Stages of Concern pre- and posttests provides insight to the first research question, To what extent does program implementation impact levels of concern? All participants ($N = 53$) completed a pre- and posttest using the Stages of Concern (SoC) survey questionnaire. In Project activities, the tests were labeled CBAM pretests and CBAM posttests. The instrument was administered at the beginning of the first training session for each individual.

The Stages of Concern instrument asked participants to rate themselves in one of six stages. The stages (1 through 6) were awareness, learning the process, understanding and application of the process, familiarity and confidence, adaptation to other contexts, and creative application to new contexts. These stages are assumed to be along an awareness-to-application continuum.

The 53 participants consisted of two cohorts. The first cohort of 42 participants began the Project in September 2005. The second cohort of 11 participants began a year later in September 2006. Posttests were given in May 2006 and then again in May 2007 for Cohort 1. Posttests were given in May 2007 and then again in May 2008 for Cohort 2. The schedule for the administration of all pretests and posttests for both cohorts is summarized in Table 2. As the table indicates, of the 42 participants in Cohort 1, all completed the pretest and posttest 1. However, only 27 completed all pretest, posttest 1

and posttest 2. Of the 11 Cohort 2 participants, all completed the pretest and posttest 1.

However, only 5 completed all pretest, posttest 1 and posttest 2.

Table 2

Pretest and Posttest Administration for Cohorts 1 and 2

Date/Test	Sept 05 Pretest 1	May 06 Posttest 1	Sept 06 Pretest 2	May 07 Posttest 2	May 08 Posttest 3
Cohort 1	$N = 42$	$N = 42$		$N = 27$	
Cohort 2			$N = 11$	$N = 11$ (1st Posttest)	$N = 5$ (2nd Posttest)

Cohort 1 Analysis

Among Cohort 1 participants, 42 took the first-year pretest and the first-year posttest with only 27 participants completing the second-year posttest. The frequency distribution of the stages of concern for Cohort 1 ($N = 42$) is shown in Table 3. The frequency distribution of the stages of concern for the 27 participants who took the pretest, first-year posttest and the second-year posttest is shown in Table 4.

Change among the 42 participants in Cohort 1 is represented in Figure 4, representing the change in percentage from pretest to the first posttest. This graph suggests a correlation between the pretest and posttest. While most of the Cohort 1 participants indicated stages 1 through 3 in the pretest (83.3%), the posttest places most of the Cohort 1 participants in stages 4 through 6 (71.4%).

A paired *t* test was applied to determine if there is a significant difference between the pretest and posttest 1. As seen in Table 5, the pretest mean score was 2.45 and the

posttest 1 mean was 4.05. The mean difference (1.6) is statistically significant ($t(41) =$ -9.17, $p < .000$) and deemed large ($d = 1.42$). This result suggests that the Project may have a significant impact on the level of concern among the 42 participants.

Table 3

Frequency Distributions for Cohort 1 with One Posttest (N = 42)

Stages of Concern	Pretest		Posttest 1	
	N	%	*N*	%
1	15	35.7	1	2.4
2	4	9.5	2	4.8
3	16	38.1	9	21.4
4	5	11.9	17	40.5
5	0	0.0	8	19.0
6	2	4.8	5	11.9
Total	42	100.0	42	100.0

Table 4

Frequency Distributions for Cohort 1 with Two Posttests (N = 27)

Stages of Concern	Pretest		Posttest 1		Posttest 2	
	N	%	*N*	%	*N*	%
1	11	40.4	1	3.7	0	0.0
2	2	7.4	1	3.7	0	0.0
3	10	37.0	7	25.9	5	18.5
4	4	14.8	12	44.4	8	29.6
5	0	0.0	5	18.5	6	22.2
6	0	0.0	1	3.7	8	29.6
Total	27	100.0	27	100.0	27	100.0

Change between the pretest, posttest 1, and posttest 2 for the 27 participants in

Cohort 1 is represented in Figure 5. This graph suggests a correlation between the pretest

and posttest 1 and between the pretest and posttest 2. The majority of these 27

participants in Cohort 1 indicated stages 1 through 3 in the pretest (85.1%), and in

posttest 2 a majority of the participants indicated stages 3 through 6 (81.4%).
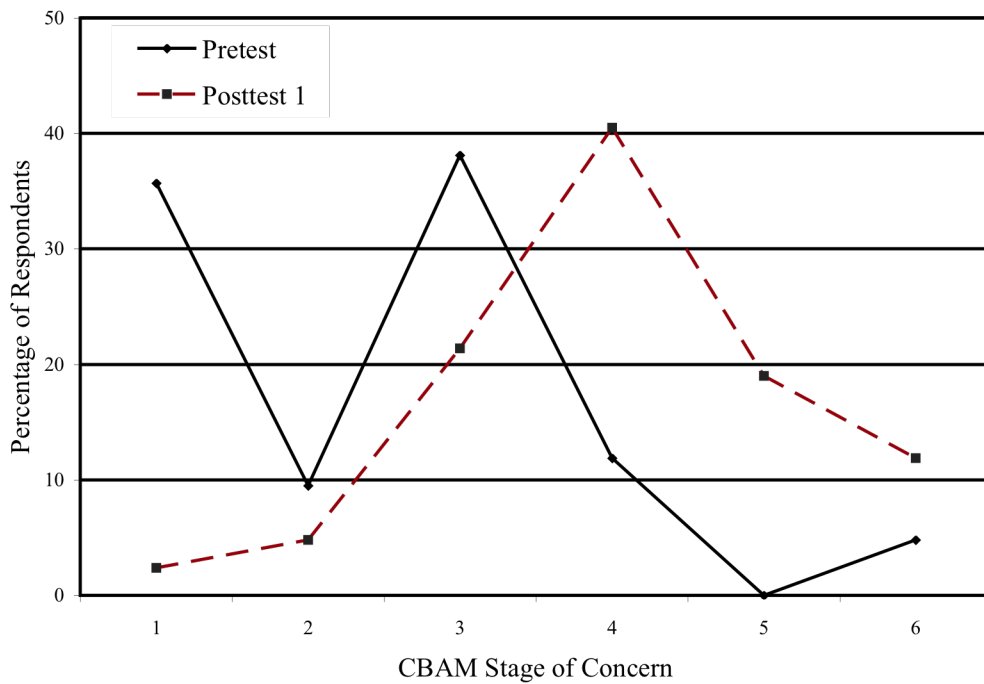
Figure 4. Percentage of CBAM responses for pretest and posttest 1 (*N* = 42).

Table 5

Cohort 1 Paired T-test Results

	N	M	SD	t	p	ES(d)
Pretest 1	42	2.45	1.35			
				-9.17	.000	1.42
Posttest 1	42	4.05	1.15			

As indicated previously, Cohort 1 includes 27 individuals who completed the SoC as a pretest at the beginning of the first year of the grant and completed posttests at both the end of the first year and the end of the second year. CBAM SoC scores are graphically represented in Figure 5. Group means and standard deviations for these 27 participants are presented in Table 6. CBAM SoC scores appear to increase from a low of 2.26 ($SD = 1.16$) at pretest to a high of 4.63 ($SD = 1.12$) at posttest taken at the end of the second year of program implementation.
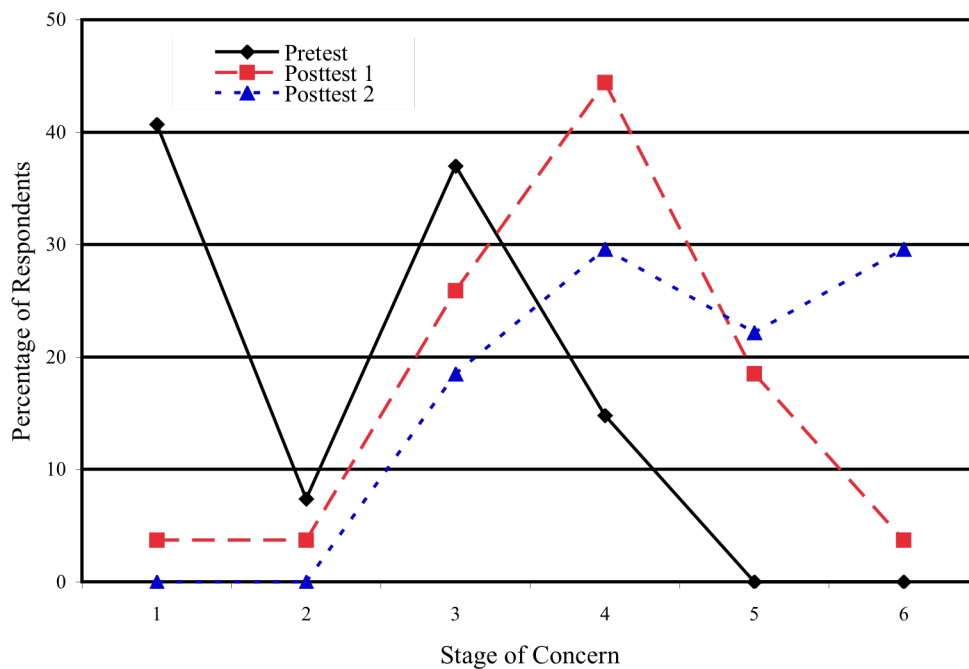
Figure 5. Percentage of CBAM responses for pretest, posttest 1, and posttest 2 ($N = 27$).

To determine if these apparent changes in CBAM SoC posttest 2 and posttest 3 scores are statistically significant, a one-way repeated measures of analysis of variance was conducted. The sphericity assumption was met (Mauchly's W = 0.99, $\chi^2 = 0.27$, $df =$

2, $p = 0.87$). As the results in Table 7 indicate, there was a significant change in CBAM

scores over the three test periods ($F_{(2,52)} = 64.28$, $p = 0.000$, $\eta^2 = 0.71$) and that

approximately 71% of the variance in level of concern scores may be explained by test

times. Pairwise comparison using Bonferroni correction indicates that there was a

significant ($p < 0.001$) increase between pretest ($M = 2.26$, $SD = 1.16$) and posttest at the

end of the first year ($M = 3.81$, $SD = 1.04$). There was also a significant ($p < 0.01$)

increase between posttest 1 ($M = 3.81$, $SD = 1.04$) and posttest 2 given at the end of the

second year of program implementation ($M = 4.63$, $SD = 1.12$). This result indicates that

the Project may have significantly impacted participants' level of concern positively.

Table 6

Cohort 1 Descriptives (N = 27)

	M	SD	N
CBAM Pretest	2.26	1.163	27
CBAM Posttest Year 1	3.81	1.039	27
CBAM Posttest Year 2	4.63	1.115	27

Table 7

Cohort 1 Repeated Measures of Analysis of Variance

	SS	df	MS	F	p	η^2
Soc	78.32	2	39.160	64.28	.000	.712
Error(between)	63.88	26	2.457			
Error(SoC)	31.68	52	0.609			

Cohort 2 Analysis

Cohort 2 included 11 participants who completed the first-year pretest (second

year of project implementation) and the second-year of program implementation posttest.

The frequency distribution of the 11 Cohort 2 participants is shown in Table 8. Among

Cohort 2 participants, five participants took the second-year pretest, the second-year

posttest and the third-year posttest. The frequency distribution of these five Cohort 2

participants is shown in Table 9.

Table 8

Frequency Distributions for Cohort 2 with One Posttest (N = 11)

Stages of Concern	Pretest		Posttest 1	
	N	*%*	*N*	*%*
1	6	54.5	0	0.0
2	3	27.3	0	0.0
3	2	18.2	1	9.1
4	0	0.0	4	36.4
5	0	0.0	1	9.1
6	0	0.0	5	45.5
Total	11	100.0	11	100.0

Table 9

Frequency Distributions for Cohort 2 with Two Posttests (N = 5)

Stages of Concern	Pretest		Posttest 1		Posttest 2	
	N	*%*	*N*	*%*	*N*	*%*
1	1	20.0	0	0.0	0	0.0
2	0	0.0	0	0.0	0	0.0
3	1	20.0	0	0.0	0	0.0
4	2	40.0	0	0.0	0	0.0
5	0	0.0	1	20.0	1	20.0
6	1	20.0	4	80.0	4	80.0
Total	5	100.0	5	100.0	5	100.0

Change among the 11 participants in Cohort 2 is shown in Figure 6, clearly showing a positive shift in the level of concern from pretest to posttest 1. There is a shift in the level of concern from pretest (81.8% in Stages 1 and 2) to a majority (91%) in Stages 4, 5, and 6 at posttest 1 (see Table 8).
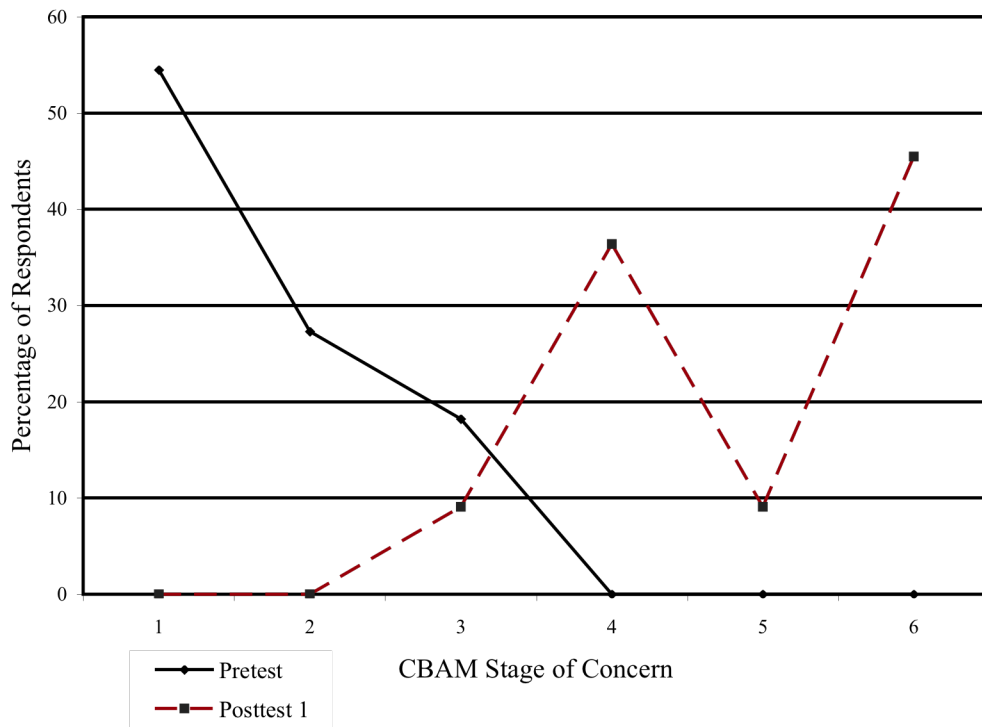
Figure 6. Percentage of CBAM responses for pretest and posttest 1 ($N = 11$).

A paired t test was applied to determine if there is a significant difference between the pretest and posttest 1. As seen in Table 10, the results indicated a significant difference between the two sets of test scores ($t(10) = -8.05$, $p < .000$, $ES(d) = 2.43$). This is a fairly large change as the pretest mean score was 1.64 and the posttest 1 mean was 4.91 with a large effect size of 2.43. The values can be viewed in relation to the CBAM SoC level. The result indicates a difference with the pretest CBAM SoC mean between

the stages awareness and learning the process to a posttest 1 CBAM SoC mean close to

the stage creative application to new contexts.

Table 10

Cohort 2 Paired T-test Results

	N	M	SD	t	p	ES(d)
Pretest 1	11	1.64	.81			
				-8.05	.000	2.43
Posttest 1	11	4.91	1.14			

The five participants who completed two posttests in Cohort 2 provide results as

represented in Figure 7. In the pretest for these five individuals, one participant indicated

stage 1, two participants indicated stage 3, and the two remaining Cohort 2 participants

indicated stages 4 and 6. After participating 1 and 2 years in Project activities, the Cohort

2 posttests reveal one participant indicating stage 4 and the remaining four participants at

stage 6. The values are unchanged between Posttest 1 and Posttest 2.

The Cohort 2 included five individuals who entered Project activities in the

second year and completed the CBAM SoC as a pretest at their initial training session in

the fall of 2006 and completed the CBAM SoC posttest at both the end of the second year

and the end of the third year. Group means and standard deviations are presented in Table

11. CBAM SoC scores appear to increase from a low of 3.60 ($SD = 1.87$) at pretest to a

high of 5.80 ($SD = .447$) at posttest taken at the end of the third year of program

implementation. For this group of five individuals in Cohort 2, the means for the two

posttests are identical ($M = 5.80$). It is notable that these 5 individuals represented a small

number of participants and this small sample did not show any change between the two posttests.
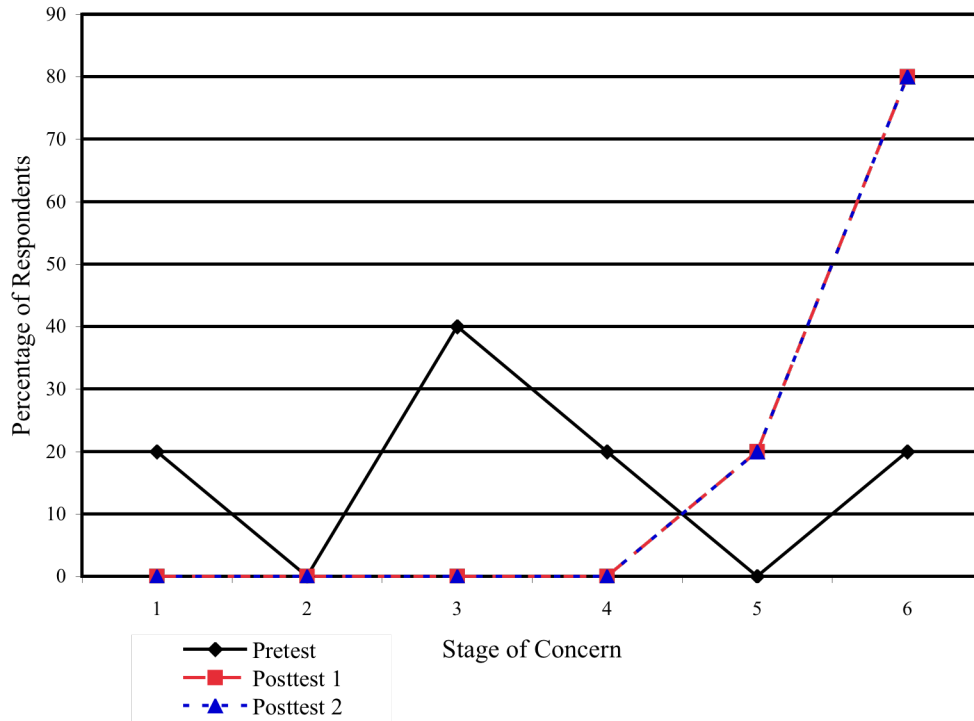
Figure 7. Percentage of CBAM responses for pretest and posttest 1 (*N* = 5). Posttest 1 and posttest 2 values are identical.

Table 11

Cohort 2 Descriptives

	M	*SD*	*N*
CBAM Pretest	3.60	1.871	5
CBAM Posttest Year 2	5.80	.447	5
CBAM Posttest Year 3	5.80	.447	5

To determine if these apparent changes in CBAM SoC scores are statistically significant, a one-way repeated measures of analysis of variance was conducted. The

sphericity assumption was not met (Mauchly's W = 0.00, χ^2 = 0.00, df = 2, p = 0.000).

Therefore, the Greeshouse-Geisser results are reported here. As the results in Table 12

indicate, there was no significant change in CBAM scores over the three test periods

($F_{(2,8)}$ = 6.54, p = 0.063, η^2 = .621).

Table 12

Cohort 2 Analysis

	SS	df	MS	F	p	η^2
SoC	16.133	2	16.133	6.54	.063	.621
Error(between)	4.933	4	1.233			
Error(SoC)	9.867	4	2.467			

Observations of All Participants

The results of pretests and final posttests of all 53 participants were observed.

While these data provide a picture of the entire population, it is based on an initial pretest

and the last posttest the participant completed. There are individuals who may have taken

multiple posttests or a single posttest. This also includes Cohort 1 that completed the

pretest in year one and Cohort 2 that completed the pretest in year 2. Further, the final

posttest of a given individual may be the year 1, 2, or 3 posttest. Table 13 provides a

frequency distribution of the pre- and posttest administrations.

Figure 8 demonstrates graphically the change that took place in pretest and

posttest participant responses. Notably the pretest showed 39.6% stage 1 responses and

3.8% stage 6 responses. The posttest shows that stage 6 responses accounted for 39.6% of

the participants.

Table 13

Frequency Distributions All Participants (N = 53)

Stages of Concern	Pretest		Posttest	
	N	*%*	*N*	*%*
1	21	39.6	0	0.0
2	7	13.2	2	3.8
3	18	34.0	6	11.3
4	5	9.4	16	30.2
5	0	0.0	8	15.1
6	2	3.8	21	39.6
Total	53	100.0	53	100.0
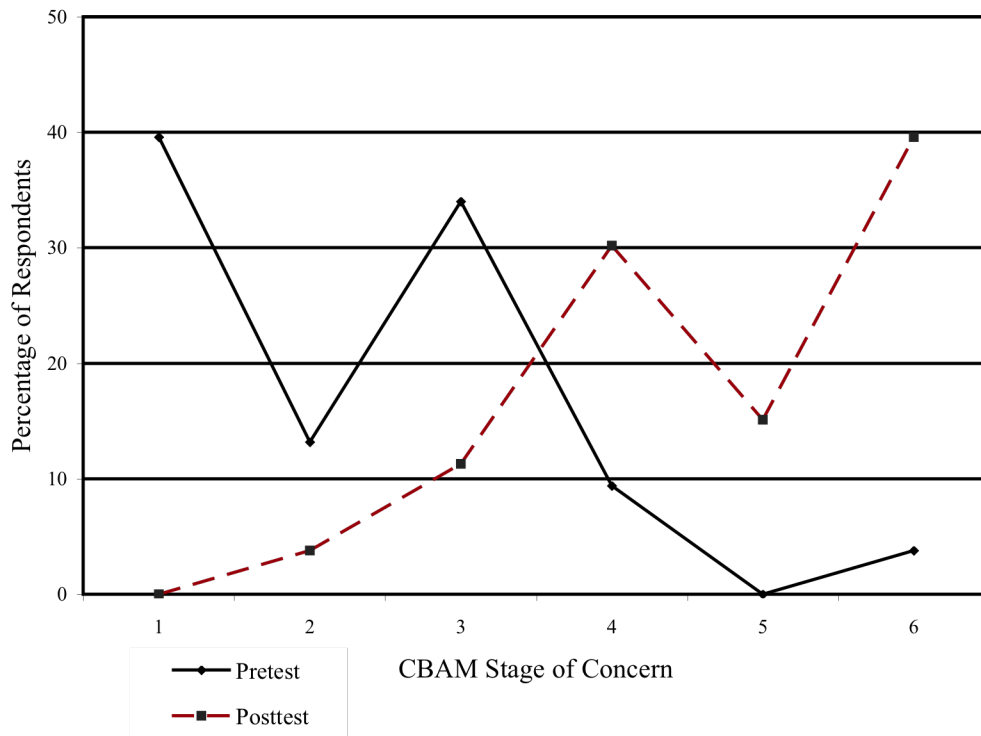
Figure 8. Percentage of CBAM responses for pretest and final posttest of all participants ($N = 53$).

In all cases, the final posttest scores were either equal to or higher when compared to the pretest scores. In the pretest, none of the participants selected stage 5, adaptation to other context, as a pretest choice. Participants responded to stages 1 through 4 and 6 in the pretest. Posttest results show that 84.9% of the participants indicated stages 4 through 6.

Relationships Among Variables

The second research questions asks, What is the nature of the relationship between a linear combination of level of concern and number of connections and the linear combination of professional development hours, equipment reliability, building-level technical support, and district-level technical support?

Much of the focus of this study is on the level of concern of the participants involved in the Project. The level of concern in this test is measured by the participants' final CBAM SoC posttest score. Zero-order correlation coefficients between level of concern and number of connections (Set 1) and professional development (PD) hours, equipment reliability, building-level technical support, and district-level technical support (Set 2) are found in Table 14. Correlation between the two variables in Set 1 is 0.295, while the correlations among Set 2 variables range from a negligible -0.012 between building technical support and district technical support, to a low 0.389 between building technical support and PD hours. There is a moderate correlation of 0.544 between PD hours and number of connections. The correlation between equipment reliability and level of concern is moderately positive at 0.650.

The relationships between the set 1 variables (level of concern and number of connections) and set 2 variables (PD hours, building technical support, equipment

reliability, and district technical support) are shown by the canonical correlation analysis

in Table 15. The correlation between the two sets of variables is 0.807 and is statistically

significant ($\chi2(8) = 26.326$, $p < 0.001$). With $r_c = 0.807$, there is 65% overlapping

variance between the two sets of variables. A single pair of canonical variates accounted

for the significant relationship between set 1 and set 2 variables.

Table 14

Correlations Between Set 1 and Set 2 (N = 28)

	LOC	NOC	PDH	BTS	ER	DTS
Set 1						
Level of Concern (LOC)	--					
Number of Connections (NOC)	0.295	--				
Set 2						
PD Hours (PDH)	0.451	0.544	--			
Building Tech Support (BTS)	0.389	0.276	0.389	--		
Equipment Reliability (ER)	0.650	0.430	0.338	0.246	--	
District Tech Support (DTS)	-0.096	0.069	0.037	-0.012	0.135	--

In order to determine if canonical variates are meaningful, variables with

canonical loadings of 0.3 are interpreted (Tabachnick & Fidell, 2001). The first and only

canonical variate indicates that low level of concern (-0.880) and low number of

connections (-0.714) are associated with low PD hours (-0.601), low building technical

support (-0.423), and low equipment reliability (-0.689). Thus, it appears that higher

levels of concern and larger numbers of connections are associated with higher PD hours,

more reliable equipment, and more adequate building technical support. District-level

technical support appears to have little influence on level of concern and number of

connections.

Table 15

Canonical Loadings and Standardized Canonical Coefficients (N = 28)

	Canonical Loadings	Standardized Canonical Coefficients
Set 1		
Level of Concern	-0.880	-0.733
Number of Connections	-0.714	-0.666
% of Variance	0.642	
Redundancy	0.048	
Set 2		
PD Hours	-0.601	-0.746
Building Tech Support	-0.423	-0.524
Equipment Reliability	-0.689	-0.855
District Tech Support	-0.027	-0.034
% of Variance	0.390	
Redundancy	0.254	
Canonical Correlation	0.807	
Wilks's	0.326	
Chi-Square	26.326	
df	8.000	
p	0.001	

Relationship of Number of Connections to Level of Concern

The third research question examined the relationship of the number of

connections to the level of concern. Specifically, in addition to professional development

85

hours, equipment reliability, building-level technical support, and district-level technical

support, to what extent is level of concern related to the number of connections? A

hierarchical regression analysis was performed to determine if the level of concern, along

with the independent variables of professional development hours, equipment reliability,

building-level technical support, and district-level technical support, is influenced by the

number of connections. As indicated earlier, the level of concern in this test is measured

by the participant's final CBAM SoC posttest.

Table 16 shows the mean and standard deviation of the variables. Zero-order

correlations between and among these variables were reported earlier in Table 14.

Table 16

Descriptive Statistics of the Variables

	M	SD	N
Level of Concern	4.82	1.278	28
PD Hours	10.00	11.431	28
Building Tech Support	6.89	1.449	28
District Tech Support	11.70	6.581	28
Equipment Reliability	3.00	1.247	28
Number of Connections	42.61	38.469	28

The results of the hierarchical regression analysis are shown in Tables 17, 18, and

19. In the first model, the set of predictors (PD hours, building-level technical support,

equipment reliability, and district-level technical support) accounted for 51.8% ($R^2 =$

0.518, $R^2_{adj} = 0.435$) of the variance in level of concern. In the second model, the set of

predictors (PD hours, building-level technical support, equipment reliability, district-level

technical support, and number of connections) accounted for 53.2% ($R^2 = 0.532$, $R^2_{adj} =$

0.425) of the variance in level of concern. Both models are statistically significant at the

0.05 level (see Table 18). The addition of number of connections to the set of predictors

in Model 2 increased the multiple R only slightly from 0.720 to 0.729. However, the

change in explained variance (0.014) is not statistically significant ($p > .05$), suggesting

that number of connections does not appreciably explain level of concern.

Table 17

Model Summary for Level of Concern

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	.720[a]	.518	.435	.961
2	.729[b]	.532	.425	.969

[a]Predictors: (Constant), PD Hours, Building Tech Support, Equipment reliability.
[b]Predictors: (Constant), PD Hours, Building Tech Support, Equipment reliability, Number of Connections.

Table 18

Analysis of Regression Summary Table for Level of Concern

Model		SS	df	MS	F	Sig.
1	Regression	22.862	4	5.715	6.187	.002[a]
	Residual	21.246	23	0.924		
	Total	44.107	27			
2	Regression	23.448	5	4.690	4.994	.003[b]
	Residual	20.659	22	0.939		
	Total	44.107	27			

[a]Predictors: (Constant), PD Hours, Building Tech Support, Equipment reliability.
[b]Predictors: (Constant), PD Hours, Building Tech Support, Equipment reliability, Number of Connections.
Note. Dependent Variable = Level of Concern.

An examination of the individual predictors in both models indicates that equipment reliability is the only variable that significantly predicts level of concern ($p < 0.01$). The zero-order correlation between level of concern and equipment reliability is 0.650 (see Table 14). Thus, equipment reliability explains about 42% of the variance in level of concern. Standardized coefficients (β) for equipment reliability are fairly stable in both models ($\beta = 0.552$ in model 1 and $\beta = 0.591$ in model 2). Other notable variables, though not statistically significant, are PD hours and building technical support.

Table 19

Regression Analysis Results

	Unstandardized Coefficients		Standardized Coefficients		
	b	Std. error	Beta	*t*	Sig.
Model 1					
Constant	1.953	0.999		1.955	.063
PD Hours	0.022	0.018	.200	1.227	.232
Building Tech Support	0.154	0.140	.175	1.100	.283
District Tech Support	-0.017	0.028	-.090	-0.613	.546
Equipment Reliability	0.566	0.160	.552	3.527	.002
Model 2					
Constant	1.899	1.010		1.881	.073
PD Hours	0.029	0.020	.263	1.440	.164
Building Tech Support	0.159	0.141	.180	1.126	.272
District Tech Support	-0.017	0.029	-.087	-0.591	.561
Equipment Reliability	0.605	0.169	.591	3.575	.002
Number of Connections	-0.005	0.006	-.145	-0.790	.438

Note. Dependent Variable: Level of Concern.

Summary of Findings

This section shares the major findings reported by the analysis for each research question. Testing for the data analysis employed statistical descriptives, paired *t* test, and one-way repeated measures of analysis of variance to address research question 1, canonical correlation to examine research question 2, and hierarchical regression analysis to examine the relationship number of connections to the level of concern in research question 3.

Research question 1 asked, To what extent does program implementation impact levels of concern? Findings for this question follow.

1. Cohort 1 ($N = 42$) participants indicated at pretest 83.3% stages 1 through 3 on the Stages of Concern instrument. At posttest 1, 71.4% of Cohort 1 indicated stages 4 through 6.

2. A paired *t* test found this change to be significantly different indicating that the Project may have a significant impact on the level of concern for Cohort 1.

3. Cohort 2 ($N = 11$) participants indicated at pretest 81.8% stages 1 and 2. At posttest 1, 91% of Cohort 2 indicated stages 4 through 6.

4. A paired *t* test found this change to be significantly different, indicating that the Project may have a significant impact on the level of concern for Cohort 2.

5. It appears that most of the change took place between the pretest and the first posttest.

6. For all participants, the final posttest scores were either equal or higher when compared to pretest scores.

Research question 2 examined the relationship between a linear combination of level of concern and number of connections and the linear combination of professional development hours, equipment reliability, building-level technical support, and district-level technical support. The canonical correlation analysis tested two sets. Set 1 contained the variables for the level of concern and the number of connections. Set 2 included variables for PD hours, building technical support, equipment reliability, and district technology support. Findings for this research question found the following:

1. The correlation between the two sets of variables is statistically significant.

2. Analysis indicated that the level of concern and the number of connections are associated with PD hours, building technical support, and equipment reliability.

3. District-level technical support appears to have little influence on level of concern and number of connections.

The third research question examined the relationship of the number of connections to the level of concern. A hierarchical regression analysis was performed to determine if the level of concern, along with the independent variables of professional development hours, equipment reliability, building-level technical support, and district-level technical support, is influenced by the number of connections. The findings are listed below:

1. Analysis indicates that equipment reliability is the only variable that significantly predicts the level of concern.

2. While not statistically significant, other notable variables are PD hours and building technology support.

3. The number of connections does not appreciably explain the level of concern.

Summary

This chapter reported the results of the analysis of the data collected in this study. Descriptive statistics were reported for each variable. The analysis of the impact of the implementation on Project activities on the level of concern was executed using one-way repeated measures of analysis of variance. Canonical correlation analysis provided data related to the linear relationships between variables and combinations of variables. Hierarchical regression analysis examined the extent the number of connections is related to the level of concern in addition to professional development hours, building-level technical support, district-level technical support, and equipment reliability.

CHAPTER 5

SUMMARY, DISCUSSION, AND RECOMMENDATIONS

Introduction

This chapter presents a summary of the study including a review of the problem, purpose, conceptual framework, procedures and research questions, and hypotheses. This is followed by discussion of data analysis, findings, discussion, and recommendations for videoconferencing in K-12 schools and further research.

Context of the Study

In February 2005, the Berrien Regional Education Service Agency (Berrien RESA) in Michigan received a 3-year $350,000 United States Department of Agriculture Rural Utilities Services Distance Learning and Telemedicine Grant (referred to as the Project). The grant award allowed Berrien RESA to purchase videoconferencing units and supporting equipment for 35 elementary and middle schools. These schools have been identified as rural and low income. Berrien RESA provided matching funds for the equipment needed to bridge multiple connections among the 35 schools. The local schools received equipment and installation at no cost at both the district and individual school levels. Project activities included initial and ongoing professional development and training for Project participants as well as support from the Berrien RESA Instructional Technology Department. Continuous training and support were delivered by the Berrien RESA Videoconferencing Coordinator and through peer interaction. Project

participants included teachers, media specialists, technology specialists, and paraprofessionals. Each building identified one participant as a building videoconferencing coordinator. To meet grant specifications, participants were required to meet a minimum level of training that included an initial training session and a professional development event or course during the 3 years of the Project implementation. Building videoconferencing coordinators were required to take additional training. Several additional professional development opportunities were offered to participants. The purpose of the implementation was to allow classroom interactive connections to various providers such as authors, zoos, and museums. In addition, classroom-to-classroom connections occurred within the Berrien RESA service area as well as worldwide.

Problem

The introduction of two-way, interactive videoconferencing as an important technology tool for K-12 education has presented the challenge for educators to learn and integrate the technology as schools are making significant investments in the equipment, infrastructure, and personnel. The implementation of new technology, including videoconferencing in the school, is often difficult due to the various concerns of educators (Habash, 1998; McCartan, 2005; Wexler, 2003). This study examined the concerns of educators as they implement technology and the factors for successful integration of videoconferencing in the curriculum.

Purpose Statement

The purpose of this study was to determine what factors predict levels of implementation of videoconferencing by participants in the federal grant and to

determine if participants' levels of concern change with the implementation of the Project activities. This study analyzed implementation factors to connect those factors to the level of concern of the participants and to the level of implementation.

Theoretical Framework

A dilemma facing the implementation of a new innovation is the ensured success of the implementation and sustainability of the change and innovation. Sustainability in this context goes beyond maintaining programs. Sustainability creates a system that ensures that innovation will continue and that there is a succession of leadership that will provide mechanisms to continue the innovation.

Owston (2007) provides a Model for Sustainability of Classroom Innovation. His model examines a number of factors that contribute to this sustainability. These are divided into essential factors and contributing factors. Essential factors include supportive plans and policies, support from outside the school, support from inside the school, funding, innovation champions, teacher support, and administrative support. Contributing factors include teacher professional development, student support, and the perceived value of innovation.

Sustainable leadership, as Fullan (2005) states, is about leadership rather than individual leaders. It is a system that provides the kind of leadership that promotes sustainability. While leaders are responsible to carry on the work, the combined system of leadership continues the change. Hargreaves and Fink (2005) state that sustainable leadership is distributed rather than delegated. It is a social activity that stretches across many people.

In the context of this study, the work of the Project, while providing necessary

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equipment, also provided extensive capacity development through training, classes, and mentoring. Leadership was evident from Berrien RESA and from individuals in the buildings. As demonstrated by Owston (2007), these factors contribute to the sustainability of the technology innovation, in this case, videoconferencing.

Procedures

This quantitative research was a single group pretest, posttest design study of an implementation of a federal grant awarded to the Berrien Regional Educational Service Agency in Michigan. In this study, the population was comprised of the participants in the 35 middle and elementary schools that received funding in the federal grant. The study compares a number of factors to determine the relationship among them.

Survey methods were applied to quantify levels of concern as well as several factors that will be discussed in this chapter. All participants who received training and professional development completed the Stages of Concern (SoC) questionnaire based on the Concerns-Based Adoption Model (CBAM) at the beginning of the training regiment. The SoC questionnaire alone is often applied to technology implementation (Christou et al., 2004; Davis & Roblyer, 2005; Gershner & Snider, 2001). The Stages of Concern instrument asked participants to rate themselves in one of six stages. The stages (1 through 6) were awareness, learning the process, understanding and application of the process, familiarity and confidence, adaptation to other contexts, and creative application to new contexts. These stages are assumed to be along an awareness-to-application continuum. The survey was completed again at the end of each of the Project's 3 years of implementation.

The design utilized data that include count data for several factors including the

number of connections to indicate the level of implementation. The data include 53

educators who participated in the Project. This study, using pre-existing data collected by

Berrien RESA for Project evaluation purposes, was conducted with two dependent

variables, the level of concern and the number of connections. These two dependent

variables were measured against the independent variables of equipment reliability,

technical support at the building level, technical support at the school district level and

the participation in training and professional development. Additionally, the relationship

of the two dependent variables among the independent variables was considered.

The Concerns Based Adoption Model was administered through a Web-based

survey. This method allowed for convenient administration and was easily accessible to

all participants. This allowed Project coordinators to easily access the database created

from the survey to be sure all participants responded completely. The survey was

administered as a pretest at the first training session for participants as each participant

accessed the survey at the beginning of the session. The initial sessions took place at the

beginning of the Project cycle. The 53 participants were divided into two cohorts. The

first cohort of 42 participants began the Project in September 2005. The second cohort of

11 participants began a year later in September 2006. Posttests were given in May 2006

and then again in May 2007 for Cohort 1. Posttests were given in May 2007 and then

again in May 2008 for Cohort 2. Of the 42 participants in Cohort 1, all completed the

pretest and posttest 1. Only 27 participants completed all pretest, posttest 1, and posttest

2. Of the 11 Cohort 2 participants, all completed the pretest and posttest 1. Five

completed all surveys, pretest, posttest 1, and posttest 2.

Web-based entries were made by the videoconferencing coordinators to provide

count data regarding the number of connections for each building. This was reviewed and confirmed by the Project coordinator as all connections were arranged or monitored by the Project coordinator and other Berrien RESA technology staff. The database created by the entries included the duration of the connections; the type of connections indicating a student program, meeting, or professional development opportunity; teacher information such as name and Email address; grade level; program provider information; date; and technical connection details.

The Project coordinators tracked the reliability of equipment in two ways. The first was observations of connections attempted but could not be completed. The Project coordinators also tracked equipment failures related to Project activities. These failures could be the result of classroom, school building-level, or district-level issues.

The building-level technology support was based on feedback from all videoconferencing coordinators in every building. This feedback was collected at the end of the second year of the Project.

The district-level technology support was assessed by the Berrien RESA technology staff. The Berrien RESA staff members worked closely with each district's technology issues related to the Project. In addition, the Berrien RESA technology staff also interacted with each district in all aspects of technology operation. These individuals provided expert input to a questionnaire to assess each district's level of technology support.

The Project prescribed a regiment of training and professional development that was provided initially as face-to-face instruction. This was followed by online short courses ranging from a few hours to several days, online long courses that met up to 15

weeks, and peer-to-peer sharing sessions with multiple buildings through the videoconferencing equipment, and internal presentations at building-level staff meetings.

Statistical tests were applied to the data collected and were used to assess if there was a relationship among the variables.

Findings

This section describes the findings for the three research questions. This will include a description of the statistical tests and the outcome of their application.

Question 1 Results

An examination of Concerns Based Adoption Model (CBAM) Stages of Concern pre- and posttests provide insight to the first research question, To what extent does program implementation impact levels of concern? As previously stated, the 53 participants consisted of two cohorts. The first cohort of 42 participants began the Project in September 2005. Among Cohort 1 participants, 42 took the first-year pretest and the first-year posttest with only 27 participants completing the second-year posttest.

In the CBAM SoC survey responses, most of the Cohort 1 participants ($N = 42$) indicated stages 1 through 3 in the pretest (83.3%); the posttest places most of the Cohort 1 participants in stages 4 through 6 (71.4%). A paired t test was applied to determine if there was a significant difference between the pretest and posttest 1. The pretest mean score was 2.45 and the posttest 1 mean was 4.05. The mean difference (1.6) was statistically significant ($t(41) = -9.17, p < .000$) and deemed large ($d = 1.42$). This result suggests that as the Project progressed the levels of concern moved away from awareness and learning process issues to expressing familiarity and confidence, the ability to adapt

videoconferencing to additional curriculum contexts, and the ability to create applications for new curriculum contexts.

To determine if these apparent changes in CBAM SoC posttest 2 and posttest 3 scores are statistically significant ($N = 27$), a one-way repeated measures of analysis of variance was conducted. There was a significant change in CBAM scores over the test periods ($F_{(2,52)} = 64.28$, $p = 0.000$, $\eta^2 = 0.71$) and that approximately 71% of the variance in level of concern scores may be explained by test times. Pairwise comparison using Bonferroni correction indicates that there was a significant ($p < 0.001$) increase between pretest ($M = 2.26$, $SD = 1.16$) and posttest at the end of the first year ($M = 3.81$, $SD = 1.04$). There was also a significant ($p < 0.01$) increase between posttest 1 ($M = 3.81$, $SD = 1.04$) and posttest 2 given at the end of the second year of program implementation ($M = 4.63$, $SD = 1.12$). As with Cohort 1 participants completing only posttest 1, Cohort 1 participants who additionally completed posttest 2 and posttest 3, this result suggests that as the Project progressed, the levels of concern continued to move away from awareness and learning process issues to higher stages of concern.

Cohort 2 included 11 participants who completed the first year (second year of the project) and the second year of the program implementation posttest. There is a shift in the level of concern from pretest (81.8% in stages 1 and 2) to a majority (91%) in stages 4, 5 and 6 at posttest 1.

A paired t test was applied to determine if there is a significant difference between the Cohort 2 pretest and posttest 1. The results indicated a significant difference between the two sets of test scores ($t(10) = -8.05$, $p < .000$, $ES(d) = 2.43$). This is a fairly large

change as the pretest mean score was 1.64 and the posttest 1 mean was 4.91 with a large effect size of 2.43.

Cohort 2 included five individuals who completed two posttests. CBAM SoC scores appear to increase from a low of 3.60 ($SD = 1.87$) at pretest to a high of 5.80 ($SD = .447$) at posttest taken at the end of the third year of program implementation. For this group of five individuals in Cohort 2, the means for the two posttests are identical ($M = 5.80$). To determine if these apparent changes in CBAM SoC scores are statistically significant, a one way repeated measures of analysis of variance was conducted. There was no significant change in CBAM scores over the three test periods ($F_{(2,8)} = 6.54$, $p = 0.063$, $\eta^2 = .621$).

The testing results indicate that for both Cohort 1 and Cohort 2, Project activities resulted in a significant difference between pretests and the first posttest completed by the two cohorts. In addition, one-way repeated measures of analysis of variance showed that significant change took place over the three test periods for Cohort 1. When the one-way repeated measures of analysis of variance was applied to Cohort 2 data, significant change was not indicated. However, only five individuals completed all three test periods so that there were not a sufficient number of data points to effectively find a significant difference. It is notable that in the case of all 53 participants, the final posttest scores were either equal to or higher when compared to the pretest scores.

Question 2 Results

The second research question asked, What is the nature of the relationship between a linear combination of level of concern and number of connections and the linear combination of professional development hours, equipment reliability, building-

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level technical support, and district-level technical support?

Testing examined zero-order correlation coefficients between level of concern and number of connections (Set 1) and professional development hours, equipment reliability, building-level technical support, and district-level technical support (Set 2). Correlation between the two variables in Set 1 was 0.295, while the correlations among Set 2 variables range from a negligible -0.012 between building technical support and district technical support, to a low 0.389 between building technical support and PD hours. There is a moderate correlation of 0.544 between PD hours and number of connections. The correlation between equipment reliability and level of concern is moderately positive at 0.650.

The relationships between the set 1 variables (Level of concern and number of connections) and set 2 variables (PD hours, building technical support, equipment reliability, and district technical support) were examined by canonical correlation analysis. The correlation between the two sets is 0.807, indicating a 65% overlapping variance and is statistically significant ($\chi2(8) = 26.326$, $p < 0.001$). A single pair of canonical variate accounted for the significant relationship between set 1 and set 2 variables.

The canonical variate indicates that low level of concern (-0.880) and low number of connections (-0.714) are associated with low PD hours (-0.601), low building technical support (-0.423), and low equipment reliability (-0.689). It appears that high level of concern and number of connections are associated with PD hours, reliable equipment, and adequate building technical support. District-level technical support appears to have little influence on level of concern and number of connections.

The results suggest that there is a relationship between the Project's professional development activities and the number of connections completed by participants as indicated by the moderate correlation between PD hours and the number of connections. This is consistent with the essential element of professional development suggested by Owston (2007) in his Model for Sustainability of Classroom Innovation. Other literature supports this as well. Keller et al. (2008) found that teachers identified professional development as a top influence in using technology in the classroom. Bose (2007) asserts that a high level of professional development resulted in a greater use of videoconferencing.

Equipment reliability and the level of concern are related based on the moderate correlation found in the testing. Examples of this relationship are found in the literature on technology implementation (Malinski, 2000; McDavid, 2003; Sandholtz et al., 1997) and, specifically, videoconferencing examples (Giuliani, 2001; Pemberton et al., 2004; Spooner et al., 2007). Reliable equipment emerges as a factor in addressing fear and concern.

The canonical correlation analysis points to a relationship between the level of concern and the number of connections taken together and the set of variables that include PD hours, equipment reliability, and building technology support. Studies by Al-Alwani (2005), Baker (2002), DeZoysa (2001), Giuliani (2001), Knipe and Lee (2002), Malinski (2000), and Westergaard (1999) point to the relationship between these sets of variables.

Question 3 Results

The third research question asked, in addition to professional development hours, equipment reliability, building-level technical support, and district-level technical support, To what extent is level of concern related to the number of connections? A hierarchical regression analysis was performed to determine if the level of concern, along with the independent variables of professional development hours, equipment reliability, building-level technical support, and district-level technical support, is influenced by the number of connections. The level of concern in this test is the participant's final CBAM SoC posttest.

The results of the hierarchical regression analysis show that, in the first model, the set of predictors (PD hours, building technical support, equipment reliability, and district technical support) accounted for 51.8% ($R^2 = 0.518$, $R^2_{adj} = 0.435$) of the variance in level of concern. In the second model, the set of predictors (PD hours, building technical support, equipment reliability, district technical support, and number of connections) accounted for 53.2% ($R^2 = 0.532$, $R^2_{adj} = 0.425$) of the variance in level of concern. Both models are statistically significant at the 0.05 level. The addition of number of connections to the set of predictors in Model 2 increased the multiple R only slightly from 0.720 to 0.729. However, the change in explained variance (0.014) is not statistically significant ($p>.05$), suggesting that number of connections does not appreciably explain level of concern.

An examination of the individual predictors in both models indicates that equipment reliability is the only variable that significantly predicts level of concern ($p<0.01$). Standardized coefficients (β) for equipment reliability are fairly stable in both

models ($\beta = 0.552$ in model 1 and $\beta = 0.591$ in model 2). As noted previously, studies identify equipment reliability as a factor that impacts fears and the level of concern and the implementation of technology measured here by the number of connections (DeZoysa, 2001; Malinski, 2000; McDavid, 2003). Other notable variables, though not statistically significant, are PD hours and building-level technology support.

Discussion

This section discusses the application of the Stages of Concern questionnaire that measured levels of concern, the results of analysis, and the current literature related to technology implementation. Conclusions based on the results and literature are shared as well.

The Owston (2007) Model for Sustainability of Classroom Innovation provided a conceptual framework for this study. Owston (2007) presents *support* in various forms as essential or contributing elements in his model. In this study, findings indicated that the primary factor that impacts an educator's level of concern is a specific area of support in Owston's model: equipment reliability. Findings, to a lesser extent, identified another significant essential element in the model: teacher professional development. The Project implementation examined in this study included a professional development element that was expressed in professional development hours.

Other areas of the model and areas that were identified as barriers in the literature (Lundgren, 2008) were addressed by the Berrien RESA staff. These included such elements described by Owston as funding, time concerns, plans and policies, and creating innovation champions. Funding for the purchase of equipment was provided by the federal grant. This equipment included classroom videoconferencing units and related

hardware at the building and district levels. The attention by the Berrien RESA staff to these areas provided support for the implementation effort.

One of the contributing elements in Owston's model is the involvement of innovation champions, individuals who promote the technology innovation as a valuable effort and inspire participants to be successful. The innovation champions in the Project emerged through the Berrien RESA Project coordinator, district-level technology staff, and building-level videoconferencing coordinators. These individuals enthusiastically led the Project and, while not measured in this study, provided leadership to propel the Project forward. This distributed leadership is in line with the concept introduced by Fullan (2005) and Hargreaves and Fink (2005). Sustainable leadership, as Fullan states, is about leadership rather than individual leaders. It is a system that provides the kind of leadership that promotes sustainability. While leaders are responsible to carry on the work, the combined system of leadership continues the effort. Hargreaves and Fink state that sustainable leadership is distributed rather than delegated. It is a social activity that stretches across many people. Innovation champions exercising this kind of activity are needed when implementing innovation technology projects.

The Stages of Concern questionnaire was a valuable instrument to measure the level of concern of the participants in this study. It provided a window into the progression of the participants in their growth in implementing videoconferencing. The data from the questionnaire clearly demonstrated change that was an increase in level from *awareness*, *learning the process*, and *understanding and application* levels to *familiarity and confidence*, *adaptation to other context,* and *creative application to new context* levels in almost every participant over the course of the Project. There was

significant change in levels of concern from pretest to posttest, with the greatest change taking place in the first year. This is likely due to the initial enthusiasm generated by embarking on a new project with new equipment and a great deal of learning about videoconferencing and the operation of the equipment, which took place in the first year of participation.

This study suggests support for the Stages of Concern questionnaire as an instrument to measure the concerns of educators as they implement technology. This is consistent with previous studies that applied the questionnaire (Christou et al., 2004; Davis & Roblyer, 2005; Gershner & Snider, 2001). The results point to the first year of implementation as being critical in the positive change in concerns. Schools implementing technology innovations should provide a well-organized, concentrated effort in training and professional development and all supporting elements during the first year when the most gain is possible.

The supporting elements in this study included professional development, equipment reliability, building-level technical support, and district-level technical support. The results indicated that there is a relationship between this group of elements to the level of concern and the number of connections completed by the participants. While the district-level technical support had little influence on the outcome, the other elements together bolstered the level of concern and the number of connections. This led to the conclusion that professional development, equipment reliability, and building-level technical support are key factors in the Project's effectiveness and that future projects should pay close attention to these elements.

As mentioned above, analysis showed that district-level technology support had

little influence on the level of concern and the number of connections. This may indicate that educators in the building do not recognize or are unaware of the technology support that takes place outside the building at the district-level. Examples of district support activities include monitoring Internet connectivity to the district, maintenance of network equipment, district-level technology planning, district network connections among buildings, and allocation of district technology funds. In the implementation of videoconferencing, educators are focused on the operation of the equipment and supporting technologies at the building-level. At the building-level, educators interact with technology support personnel on site and are more attuned to the technology challenges at hand in their building. Technology issues are much less visible to educators outside their building.

This study found that equipment reliability issues had an impact on the participants' level of concern and the number of connections and was a predictor in addressing the level of concern. As equipment becomes more reliable, the educators involved in videoconferencing will indicate a higher stage on the Stages of Concern questionnaire. The conclusion drawn here is that higher levels of equipment reliability will contribute to a higher level of application by those involved in implementation. The number of connections is an indicator of success of the implementation of videoconferencing in a school. The data indicate that more reliable equipment will increase the number of connections and that problems with equipment will stifle technology use. As the literature suggests, problems with equipment are a barrier to technology implementation (Carpenter, 2004; de la Garza, 2006; DeZoysa, 2001; Malinski, 2000; Passmore, 2007; Pemberton et al., 2004). The frequency of

videoconferencing events, and the integration in the classroom that follows, will increase with more reliable equipment.

The findings related to equipment reliability are notable as the successful implementation of videoconferencing in the classroom is largely dependent on educators being confident that the equipment will function as expected. By eliminating the concern over technology reliability issues, educators can concentrate on the application of the technology to achieve curriculum and communication goals. Unreliable equipment will result in greater concerns and anxiety and the likelihood that educators will not move forward in videoconferencing use if reliability continues to be a concern.

In this study, equipment reliability was attended to by the videoconferencing coordinators, building- and district-level technology support personnel, and Berrien RESA technology staff. This was accomplished by:

1. Quality videoconferencing equipment was purchased at the beginning of the project.

2. Network and Internet connections were upgraded as necessary for reliable connections.

3. Building-level technology infrastructure was carefully maintained.

4. The technology staff at the building level and at Berrien RESA and the building videoconferencing coordinators monitored and maintained the videoconferencing equipment and network infrastructure.

5. All staff quickly addressed equipment problems.

Building-level technical support was identified in the results of the study as a factor that influenced the level of concern and the number of connections. This is

consistent with the literature related to technology integration (Giuliani, 2001; McDavid, 2003). It is notable that district-level technology support does not seem to be a factor. It would appear that the building-level support is more effective as this local support is more immediate and there may be a stronger working relationship between individuals conducting conferences and those in the building who provide support. Timely technical support provided at the building-level is crucial to the person running the videoconference. As the CBAM SoC data found, an essential factor that addresses the level of concern for individuals is the assurance that equipment is reliable.

The results of this study indicate that increased professional development of participants will result in an increased number of connections. Professional development is an essential element in the implementation and sustainability of an innovation (Owston, 2007). The literature reports that the lack of professional development is a barrier to technology implementation (Al-Alwani, 2005; Baker, 2002; Cassell, 2005; Giuliani, 2001; Kirst, 2005; Madi, 2005; Malinski, 2000). The conclusion that emerges is that a professional development effort is key to the success of videoconferencing implementation especially in the first year of implementation. The integration of the technology in the classroom is enhanced with training and professional development.

This discussion can be summarized by stating the Stages of Concern questionnaire proved to be an effective instrument in the study of technology implementation. The data pointed to three variables, equipment reliability, building-level technical support, and professional development, that indicated an impact on the participants as demonstrated by the results related to the level of concern and the number of connections. Analysis found that district-level technology support did not appear to

significantly affect the implementation. The number of participants at 53 may have not provided a robust enough sample to show significant results in some instances as the literature would indicate that those variables contribute to technology implementation. Higher levels of equipment reliability, adequate building-level technical support, and a high level of professional development will contribute to a higher level of videoconferencing implementation. It is essential that as videoconferencing projects are implemented, these factors are addressed by leaders at all levels.

Recommendations for Practice

The following recommendations are for schools embarking on videoconferencing implementation.

1. Apply the Stages of Concern questionnaire to participants at the onset of videoconferencing implementation and monitor the participants' progress through the stages to ensure that participants' concerns are addressed by focusing on professional development on their concerns.

2. Take measures to ensure that equipment is reliable, that the operation of the equipment is closely monitored, and minimize technical problems through a coordinated effort by technology staff at all levels.

3. Assure adequate technology support at the building-level that is timely and monitored by the technology staff.

4. Institute a comprehensive professional development regimen for all involved in the videoconferencing implementation, with a concentrated effort in the first year of implementation.

5. Identify sources of funding beyond the federal grant in this study. Sources may

include private grants, foundations, or industry grants from equipment providers.

Recommendations for Further Research

The use of videoconferencing continues to emerge as a tool for learning in the classroom. Additional research is needed related to videoconferencing implementation in K-12 schools to aid in successful and meaningful implementation. The following recommendations are for further research in the field.

1. The United States Department of Agriculture and other agencies continue to provide funding for videoconferencing projects in K-12 schools. A multiple-case study of grant implementations would enhance the body of research. Data could be combined from several grants in a summary of the cases to develop a robust study.

2. Create a longitudinal study of videoconferencing implementation projects that would examine the sustainability of videoconferencing implementation over time.

3. Replicate this study in a similar setting with additional variables that would examine a more robust data set.

4. Replicate this study with a control or comparison group.

5. Further research is needed based on Owston's Model for Sustainability of Classroom Innovation that would include all aspects of the model in a videoconferencing implementation.

Summary

The implementation of videoconferencing in K-12 schools presents challenges for successful integration in the classroom. There are tools, such as the Stages of Concern instrument of the Concerns-Based Adoption Model, that can monitor concerns to ensure staff is confident as they implement the technology. This study identified equipment

reliability, building-level technical support, and professional development as keys to successful videoconferencing implementation. Equipment reliability is most essential to the successful implementation of videoconferencing in schools. Schools should monitor staff concerns as implementation takes place, ensure that equipment is reliable, provide adequate building-level technical support, and institute a comprehensive training and professional development effort that continues throughout the implementation process.

APPENDIX A

STAGES OF CONCERN INSTRUMENT

Videoconferencing Adoption Survey

ID: _____ Group:_____	**Use the ID assigned to you.**

Part I Instructions:
Please read the descriptions of each of the six descriptors as they relate to the adoption of videoconferencing. Place an X in the box to the left of the descriptor that best describes your feelings about videoconferencing today.

	I am aware that videoconferencing exists but have not used it - perhaps I'm even avoiding it. I am anxious about the prospect of using videoconferencing.
	I am currently trying to learn the basics. I am sometimes frustrated using videoconferencing. I lack confidence when using videoconferencing technology.
	I am beginning to understand the process of using videoconferencing and can think of specific uses in which it might be helpful to me in my role .
	I am gaining a sense of confidence in using the videoconferencing for specific purposes (e.g. instruction; professional development; meetings; communications; etc.). I am starting to feel comfortable using the videoconferencing technology.
	I think about the videoconferencing as a tool to help me and am no longer concerned about it as videoconferencing. I can use it in many applications and as an instructional aid.
	I can apply what I know about videoconferencing in the classroom. I am able to use it as an instructional tool and integrate it into the curriculum.

What are some of the barriers that limit you from moving to a higher level of proficiency as it relates to videoconferencing?

What additional professional development activities are needed to help you and/or your colleagues move to more proficient use of videoconferencing?

Please use this space for any other additional comments you may have related to professional development and videoconferencing.

Thank you for your time.

APPENDIX B

DISTRICT TECHNOLOGY SUPPORT RUBRIC

DISTRICT TECHNOLOGY SUPPORT RUBRIC

RUS Grant Data
June 2008

The purpose of this assessment is to collect data for an evaluation of the RUS grant. The RUS grant provided 35 videoconferencing units to rural middle and elementary schools in the districts listed. This data will provide some insight as to the impact of the level of district technical support on the implementation of the grant.

Video Conferencing Coordinators are individuals in the buildings that serve as the key contact for the grant and guide the videoconferencing activities of the building. These individuals may be teachers, media specialists, paraprofessionals or serve in other positions in the building.

Please return this survey to Dennis Lundgren by Friday, June 27.

For each question, placed an "X" in the box to indicate the level for each district.

1. Level of Technology Support for the Video Conferencing Coordinators

	1	2	3	4
	Little support			Much Support
Berrien Springs				
Bridgman				
Buchanan				
Cassopolis				
Coloma				
Dowagiac				
Eau Claire				
Edwardsburg				
Galien				
Marcellus				
New Buffalo				
Niles				
River Valley				
Watervliet				

2. Level of Technical Knowledge of Individuals Providing Technology Support for the Video Conferencing Coordinators

	1	2	3	4
	Little knowledge			Much Knowledge

Berrien Springs
Bridgman
Buchanan
Cassopolis
Coloma
Dowagiac
Eau Claire
Edwardsburg
Galien
Marcellus
New Buffalo
Niles
River Valley
Watervliet

3. Timeliness of Technology Support for the Video Conferencing Coordinators

	1	2	3	4
	Slow response			Quick response

Berrien Springs
Bridgman
Buchanan
Cassopolis
Coloma
Dowagiac
Eau Claire
Edwardsburg
Galien
Marcellus
New Buffalo
Niles
River Valley
Watervliet

4. Level Cooperation/coordination with BCISD of Technology Support for the Video Conferencing Coordinators

	1	2	3	4
	Low Level			High Level

Berrien Springs
Bridgman
Buchanan
Cassopolis
Coloma
Dowagiac
Eau Claire
Edwardsburg
Galien
Marcellus
New Buffalo
Niles
River Valley
Watervliet

5. Structure of Technology Support for the Video Conferencing Coordinators

	1	2	3	4
	Outside vendors, little internal support			Quality internal support

Berrien Springs
Bridgman
Buchanan
Cassopolis
Coloma
Dowagiac
Eau Claire
Edwardsburg
Galien
Marcellus
New Buffalo
Niles
River Valley
Watervliet

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REFERENCE LIST

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Publications

Lundgren, D. D., Laugen, R. C., Lindeman, C. A., Shapiro, M. J., & Thomas, J. (2011). *Schools like ours: Realizing our STEM future*. Lynchburg, VA: National Consortium of Specialized Secondary Schools for Mathematics, Science and Technology.

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Awards

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