THE DIFFUSION OF COMPUTER-BASED TECHNOLOGY IN K–12 SCHOOLS: TEACHERS' PERSPECTIVES

JOHN LOUIS COLANDREA

B.A., University of Dayton, 1967
M.A., Stony Brook University, 1973
M.S. Ed., College of New Rochelle, 2003

Mentor
Bruce S. Cooper, Ph.D.

Readers
Paul J. Lynch, Ph.D.
Carlos R. McCray, Ed.D.

DISSERTATION

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DEDICATION

This dissertation is dedicated to my late mother, Maria. Her love, support, and endless encouragement through the years enabled me to develop the skills necessary to accomplish this task.

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Abstract

THE DIFFUSION OF COMPUTER-BASED TECHNOLOGY IN K–12 SCHOOLS: TEACHERS' PERSPECTIVES

John Louis Colandrea, Ed.D.

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Mentor: Bruce S. Cooper, Ph.D.

Because computer technology represents a major financial outlay for school districts and is an efficient method of preparing and delivering lessons, studying the process of teacher adoption of computer use is beneficial and adds to the current body of knowledge. Because the teacher is the ultimate user of computer technology for lesson preparation and delivery, it is important to understand what motivates teacher computer technology use. As teachers are responsible for implementing computer technology use and computer technology is considered to be an innovation, Rogers' diffusion of innovations theory was used to understand the process of teacher adoption of computer technology use. The findings from this research provided information on the demographics of teachers and schools as well as how leadership and teacher attributes influence the job satisfaction of teachers related to technology use, the effective use of computer technology in lesson planning, the effective use of computer technology in positively affecting students, and compatibility with traditional teaching methods. This study suggests that teacher attributes, school attributes, leadership, and teacher qualities are all important in promoting computer technology use by teachers in lesson preparation and delivery.

CHAPTER I

THE PROBLEM

Introduction

The public education policy of the United States was changed dramatically by the enactment of the No Child Left Behind (NCLB; 2002) legislation. The major goal of this legislation sought to improve student achievement. The legislators who drafted the NCLB Act recognized the value of computer technology as a tool to improve student achievement and, thus, required computer technology use in K–12 education.

> PRIMARY GOAL: The primary goal of this part is to improve student academic achievement through the use of technology in elementary schools and secondary schools.
>
> ADDITIONAL GOALS: The additional goals of this part are the following:
>
> (a) To assist every student in crossing the digital divide by ensuring that every student is technologically literate by the time the student finishes the eighth grade, regardless of the student's race, ethnicity, gender, family income, geographic location, or disability.
>
> (b) To encourage the effective integration of technology resources and systems with teacher training and curriculum development to establish research-based instructional methods that can be widely implemented as best practices by State educational agencies and local educational agencies. (NCLB, 2002)

More recently, Race to the Top (American Recovery and Reinvestment Act, 2009) made computer technology use in K–12 schools a requirement for obtaining federal funds. Political and educational leaders, eager to reap the monetary incentives attached to this federal initiative, implemented computer use as an educational standard. This legislation has had broad implications for both educational leaders and teachers.

Studies suggest that the primary determinant of whether computer technology use succeeds or fails is the teacher (Albirini, 2007; Brush & Bitter, 2000; Cagle & Hornik, 2001). The skills and attitudes of the teacher determine the effectiveness of technology integration into the curriculum (Cuban, 2001; Ravitz, Becker, & Wong, 2000). These studies also suggested that the comfort level and skills of teachers may affect their use of technology.

Problem Statement

This study examined how educational leader support (principal, assistant principal, and instructional leader), school demographics, and teacher knowledge of and attitudes toward computer technology affect teacher computer technology use in lesson preparation and delivery. Do teachers, as they report it, use computer-based technology in preparing and delivering lessons, performing student assessment, and assigning research topics? How do teachers, as they report it, view the use of computer technology as affecting their job satisfaction, and do they view the use of computer technology as being compatible with traditional lesson delivery? Because the use of technology in the classroom is directly influenced by the teacher, researching and understanding the factors that contribute to teacher implementation of computer technology would be extremely important.

During the past decade, public education expenditures on, access to, and use of computer-based hardware and software by teachers and students have increased markedly (Albirini, 2007; J. R. Campbell, 2000). Have these expenditures been justified? Are teachers using computer technology to prepare and deliver lessons? Because the teacher is the main determinant in using computer technology in lesson preparation and delivery (Albirini, 2007; Brush & Bitter, 2000; Cagle & Hornik, 2001), using computer technology in the classroom requires teacher buy-in.

Teacher preparation classes that explore new methods and technologies could positively affect teacher buy-in.

The majority of studies on teacher technology education in college explore the following issues: What teachers are and/or should be learning in technology courses (Cagle & Hornik, 2001; Grove, Strudler, & Odell, 2004; Hargrave & Hsu, 2000); teacher-education students' knowledge of and attitudes toward technology (Atkins & Vasu, 2000; L. Campbell, 2000; Hsu, Huang, & Wu, 2007); and how teachers think about and use computers in the classroom (Becker, 1999; Confrey, Sabelli, & Sheingold, 2002; El-Amin et al., 2002).

Much of this research suggests that teacher-education technology courses and programs have a limited impact on how teachers think about and implement technology (Albirini, 2007; Christensen, 2002; Cuban, 2001; Hong & Koh, 2002; Rovai & Childress, 2003; Schrum, Grant, & Skeele, 2002). Fear of change, lack of training, degree of personal use, teaching models, school climate, motivation, and leader support affect the teachers' use of computer technology (Afshari, Baker, Luas, & Fooi, 2009; Becker, 1999; Braun, 2008; Cuban, 2001; Vannatta & Fordham, 2004). Before computer technology can effectively be used to make positive changes in education, teachers, ultimately responsible for the classroom, must be considered. Teachers must learn to use this innovative technology and must allow it to change their present teaching paradigm. Leaders must facilitate this change. As adopting change is not an easy task, it was valuable to study the process of adopting change (Rogers, 1995, 2003).

The process of adopting innovations has been examined for over 100 years. One of the models frequently used to comprehend change is the Rogers' (1995, 2003) diffusion of innovations theory. This theory is the most appropriate for investigating the adoption of technology in the K–12 educational environment (Medlin, 2001; Parisot, 1995). Rogers (2003)

proposed that the "full use of an innovation is the best course of action available" and rejection is a decision "not to adopt an innovation" (p. 177).

Some researchers have explored teachers' lack of adoption of computer technology guided in part by Rogers' (2003) diffusion of innovations theory. This theory shed light on the adoption of computers in graphic arts (Degennaro & Mak, 2002), using e-mail by K–12 foreign-language educators (Shelley, Cashman, Gunter, & Gunter, 1999) integrating computer applications by higher education faculty (Blankenship, 1998; Grove et al., 2004; Hansen & Salter, 2001; Less, 2003), and technology training (Casmar & Peterson, 2002). Rogers' diffusion of innovations theory was used to help understand how teachers adopt the use of computer technology in their preparation and delivery of lessons.

Purpose of the Study

This study focused on how teachers comply with the requirements of federal and local educational agencies and school leaders in using computer technology in their classrooms. Because technology represents a major financial outlay and an efficient method of preparing and delivering lessons (Barron, Harmes, Kalaydjian, & Kemker, 2003; Hsu et al., 2007), studying the process of teacher computer use is beneficial and adds to the current body of knowledge. The results of the study are also useful to leaders in their attempt to comply with federal and local requirements.

This study analyzed the relationship between leader support of teachers' use of computer technology in the preparation and delivery of lessons. The above relationships were demonstrated by using a teacher self-report survey. This survey asked teachers to give their impressions of leader support, their relations with colleagues, their school technology policies, and their attitudes toward and knowledge of computer technology. Demographic data, such as

teacher's age, years of service, gender and race, subjects taught, and level of school, also was collected.

This research reviewed related literature on the diffusion of innovations theory proposed by Rogers (2003). Much of the literature related to technology in education addresses teacher education in technology from the perspective of professional development of teachers (Afshari et al., 2009), teacher self-efficacy (Vannatta & Fordham, 2004); teacher preparation (Baarnes, 2006; Cagle & Hornik, 2001; Lewandowski & Osika, 2003; Pope, Hare, & Howard, 2002; Schrum et al., 2002); and teacher attitudes toward technology (Atkins & Vasu, 2000; Ravitz et al., 2000).

As the integration of computer technology in the schools is a public policy focus, it is important to examine how these factors influence teachers' use of computers in the classroom (Barron et al., 2003; Hsu et al., 2007). Information gathered from researching leader support of teachers in their use of computer technology and the process of teacher adoption of such technology is useful in implementing such technology.

Diffusion of innovations theory is deemed appropriate for the study of computer technology adoption (Rogers, 2003). Researchers, including Blankenship (1998), Less (2003), Medlin (2001), Surendra (2001), and Zakaria (2001), have explored faculty members' lack of adoption of computer technology, guided in part by Rogers' (1995, 2003) diffusion of innovations theory. This research has focused on the adoption of computer use in lesson planning, classroom instruction (Medlin, 2001; Zakaria, 2001), and integration of computer applications by higher education faculty (Blankenship, 1998; Carter, 1998; Less, 2003; Surendra, 2001).

This study seeks to contribute to and enhance the body of knowledge on teachers' use of technology in lesson preparation and delivery. How does leader support, a clear technology policy in the school/district, computer maintenance support, teacher attitudes and knowledge, and teacher relation to colleagues influence teachers' use of computer technology for lesson planning and delivery? Other variables also were considered, namely: job satisfaction, effective use of computer technology for lesson preparation, effective use of computer technology for lesson delivery, and compatibility with traditional lesson delivery. Conclusions from this study provide data on how these factors affect teacher use of computer technology in education.

The use of computer technology use in lesson preparation and delivery can be challenging because it is not the traditional method. Traditionally, teachers use a lecture format to deliver lessons. Rogers' (2003) diffusion of innovations theory was used to fully understand how people adopt an innovation. Following extensive and continuous research, Rogers found five attributes of innovations that influence the decision process that allows for the adoption or rejection of an innovation. The attributes include relative advantage, compatibility, complexity, trialability, and observability. These attributes, according to Rogers, affect the decision to adopt or reject an innovation. Adoption will ensure continued use of the innovation. Rejection will ensure the disuse of the innovation.

Research Questions

Using Rogers' (2003) diffusion of innovation theory as a guide, the researcher examined the following questions:

1. How does leader support of teachers affect teacher use of computer technology in lesson preparation and delivery?

2. To what extent does leader support of teachers influence teacher practices, job satisfaction related to technology and teacher job satisfaction?
3. To what extent do teacher attitudes toward and knowledge of technology affect the use of computer technology in lesson preparation, delivery?

These questions were analyzed though a quantitative analysis (SPSS) of data collected on the factors related to technology adoption in the classroom. In addition, teacher use of computer technology was analyzed in relation to teacher job satisfaction specific to technology, compatibility with teacher practices, and teacher effective use of computer technology for lesson preparation and delivery.

Significance of the Study

There is currently an explosion of multimedia digital technology and computer hardware and software technology in the K–12 schools (Albirini, 2007; Vannatta & Fordham, 2004). Preparing and delivering lessons with the use of computer technology has been required by public policies such as NCLB (2002) and Race to the Top (American Recovery and Reinvestment Act, 2009). Because computer technology requires a substantial financial investment, studying its adoption and use by teachers becomes essential. There remains a question, however, as to the process of how teachers become adopters of computer technology use. Therefore, to understand the process, the researcher examined leader support, clear leadership policies on the use of computer technology, computer maintenance support, colleague use of computer technology, and teacher attitudes toward and knowledge of computer technology.

For the students to learn with the aid of computer technology and be technologically competent, teachers must be trained, have leader support, have access to computer technology,

and have positive attitudes and behaviors toward the use of this technology (Medlin, 2001). Is it reasonable to expect that education be positively affected by the use of computer technology if the teachers are not committed to using it in effective ways? It is, therefore, important to study the process that teachers go through as they adopt or reject this innovation.

Assumptions

1. New York State school administrators supervise teachers in their use of computer technology in lesson preparation, and delivery.
2. In New York State, school teachers are responsible for the delivery of instruction and increasing the level of student achievement. Computer technology is the medium used for lesson preparation and delivery.
3. The survey instrument, Teacher Review and Assessment of Computer Technology (TRACT), used in this study, could demonstrate statistical significance and reliability as required.
4. Participants answered the questions on the survey openly and honestly.

Limitations of the Study

1. The results of this study were limited to the responses by teachers in New York State elementary and secondary schools who participated in this study. Generalizations cannot be made beyond the scope of this study.
2. This study did not measure the influence of technology use in curriculum development and delivery on actual student achievement of any of the participating schools.
3. This study was not a longitudinal study; therefore, results were limited to teachers' responses at one point in time.

Definition of Terms

Administrative support: Administrative support includes the pre-established and approved technology curriculum used or mandated by administrators. District level leaders include the superintendent, the assistant superintendent for instruction, and the director of technology. Building level leaders include principals, assistant principals, and teacher coordinators.

Teacher education: Number of years of post-high school education and number of degrees granted.

Teacher experience: Number of years of actual teaching in the classroom setting.

District size: District size includes number of and levels of schools in the district.

School size: School size refers to the number of students and teachers in a given school.

Level of technology (high/low tech): Level of technology of a school refers to the assessment by teachers of the amount of computer technology available in that school. This includes hardware and software availability.

Grade taught: Grades included K–12.

Subject taught: Subjects were classified as elementary school, science (biology, chemistry, physics, earth science, marine science, ecology, general), mathematics (specific course), foreign languages (specific language), English, social studies, physical education, art, music, and computer technology.

Principal: The instructional leader of an individual school within a school district. The school principal is supervised by the superintendent of schools.

*Computer technology: C*omputer based technology, including hardware and software.

Use of computer technology in lesson planning: Teacher-reported use of computer hardware and software in the preparation of lessons.

Use of computer technology in lesson delivery: Teacher-reported use of computer hardware and software in the delivery of lessons.

Use of computer technology for assessment: Teacher-reported use of computer hardware and software for student assessment including evaluations and exams.

Use of computer technology for research: Teacher-reported use of computer hardware and software to research subject matter.

Compatibility with teacher practices: Teacher-reported levels of adoption of computer based technology related to compatibility of their teaching practices as based upon Rogers' (2003) diffusion of innovations theory.

Job satisfaction: "Job satisfaction refers to an overall affective orientation on the part of individuals toward work roles which they are presently occupying" (Kelleberg, 1977, p. 126).

Teacher efficacy: Teachers' belief or conviction that they can influence how well students learn (Guskey & Pissaro, 1994).

Organization of the Study

This study is organized into five chapters. Chapter I provides an introduction to the topic, a statement of the problem, and the purpose of the study, as well as the significance, assumptions, limitations, and definitions of terms in the study. Chapter II reviews the relevant research literature in the areas of public policy related to computer technology use in lesson preparation and delivery. The related literature was researched to understand how writings on leader support, clear leadership policies on the use of computer technology, computer maintenance support, and dissemination of innovation theory support or reject current policy. Chapter III contains the design and methodology of the study. A survey instrument was

disseminated to teachers, and the collected data were used for analysis. Chapter IV presents the findings. Chapter V provides a discussion the results and implications of the study.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

Introduction

Recent education reforms in the United States (NCLB, 2002) have required the use of computer technology in the K–12 classroom for the preparation and delivery of lessons. The use of this technology has been viewed as a definite help in lesson preparation and delivery. Educational leaders bear the responsibility of ensuring compliance with current requirements. Educational leaders must provide support for the use of computer technology, have clear policies on the use of computer technology, and provide support for the maintenance of the computers and the network. However, teachers are the ones who use computer technology in lesson preparation and delivery. Therefore, it is valuable to review the literature on teachers' attitudes toward computer technology and the value they place on using this technology in their lesson preparation and delivery.

Over the past decade, the learning process has shifted from individual student work to collaborative group activity (Stahl, 2006). In this new learning environment, knowledge is acquired from exploration and critical examination of information rather than primarily from teacher lectures and textbook reading (Stahl, 2006). Technology, when used as a tool, fosters the ability of students to solve problems, think independently, and collaborate with others. The use of computer technology plays an important role as a new tool for teaching and student learning (Confrey et al., 2002; McCoy, 1999). This chapter explores the greater body of literature relevant to the study of the teachers' use of computer technology and their perceived support from educational leaders.

Rogers' Diffusion of Innovations Theory

Because computer technology is a recent innovation, adoption or rejection affects the use or lack of use of it for lesson preparation and delivery. Rogers' (2003) diffusion of innovations theory provides a framework for understanding the process whereby an innovation is adopted or rejected. *Diffusion* is the process by which an innovation is communicated through certain channels over time among members of a social system (Rogers, 2003).

The definition contains four elements that are present in the diffusion of innovations process. An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption. Communication channels are the means by which messages get from one individual to another. Time has three factors: innovation decision time, relative time with which an innovation is adopted by an individual or group, and the innovation's rate of adoption. The social system is a set of interrelated units that are engaged in joint problem solving to accomplish a common goal.

The original diffusion research was done as early as 1903 by a French sociologist, Gabriel Tarde, who plotted the original S-shaped diffusion curve. Tarde's S-shaped curve is of importance because "most innovations have an S-shaped rate of adoption" (Rogers & Shoemaker, 1971, p. 101). The S is steeper when the rate of adoption is fast and has a more gradual slope when adoption is slower. The rate of adoption has become an important area of research in relation to the acceptance and use of new technologies.

In 1943, two sociologists, Bryce Ryan and Neal Gross, did a study of Iowa farmers and their adoption of hybrid corn seed. The adoption rate of the farmers was similar to the S-curve graphed by Tarde 40 years earlier. They classified the Iowa farmers into five segments: innovators, early adopters, early majority, late majority, and later adopters. Rogers identified

several characteristics for each of the five segments. Innovators are venturesome and have a desire for the rash and daring. They have the ability to understand complex technical knowledge. They have the ability to cope with a high degree of uncertainty. Early adopters are an integral part of the social system. They serve as role models for other members of the society. They are successful and respected by their peers. They hold the largest percentage of opinion leadership.

The early majority represents one of the largest segments of the population, about one-third. They seldom hold positions of leadership but frequently interact with their peers. They deliberate some time before adopting a new idea. The late majority is about the same size as the early majority. They are skeptical and cautious. They will adopt an innovation due to economic necessity or peer pressure. The later adopters are the last one-third of the population. They hold on to traditional values. They are usually isolated. Their point of reference is the past.

Sahin and Tompson (2006) studied the faculty of the Anatolian university in Turkey using Rogers' (2003) diffusion of innovations theory. They found that the faculty fell into the aforementioned Rogers' categories nicely. The faculty exhibited the same characteristics presented in Rogers' theory.

> The innovation-decision process is the process through which an individual (or other decision-making unit) passes from gaining initial knowledge of an innovation, to forming an attitude toward the innovation, to making a decision to adopt or reject, to implementation of the new idea, and to implementation of this decision. (Rogers, 2003, p. 168)

In the awareness stage, an individual is exposed to the innovation but does not have the complete picture. At this stage, the individual becomes interested in the new idea and seeks

additional information. In the evaluation stage, the individual mentally applies the innovation to his or her present and anticipated future situation and then determines whether or not to try it. During the trial stage, the individual makes full use of the innovation. At the adoption stage, the individual determines whether to continue the full use of the innovation (Rogers, 2003).

Attributes of an innovation also influence the decision process to either adopt or reject the innovation (Rogers, 2003). These attributes of an innovation include relative advantage, compatibility, complexity, trialability, and observability. Rogers categorized the attributes of innovation and hypothesized that, if people met these attributes, they were significantly more likely to be persuaded to make a decision to implement and, eventually, adopt an innovation. Rogers related these attributes to persuasion, which affects the decision to adopt or reject and innovation. Confirmation would then take place and determine the continued use of the innovation.

Relative advantage "is the degree to which an innovation is perceived as being better than the idea or innovation that it supersedes" (Rogers, 2003, p. 229). The degree of relative advantage is often related to economic advantage, as conveying social prestige. The nature of the innovation itself determines the specific type of relative advantage that may be important to adopters. Characteristics of adopters also may influence which specific dimensions of relative advantage are most important to them (Rogers, 2003).

Compatibility "is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and the needs of potential adopters" (Rogers, 2003, p. 240). An innovation that is more compatible with the potential adopter and fits more closely with the individual's situation is viewed as more familiar, thus, more likely to be adopted. This compatibility may relate to (a) socio-cultural values and beliefs, (b) previously introduced ideas,

and/or (c) client needs for the innovation (Rogers, 2003). Perceived compatibility is positively related to the rate of adoption (Rogers, 2003).

Complexity "is the degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers, 2003, p. 257). An innovation may always be classified on the complexity-simplicity continuum. Some innovations are clear in their meaning to potential adopters. Rogers suggested that the degree of perceived complexity of an innovation is negatively related to its rate of adoption.

Trialability "is the degree to which an innovation may be experimented with on a limited basis" (Rogers, 2003, p. 258). Trying out an innovation is a way for an individual to give meaning to an innovation and to find out how it works. The ability to trial an innovation can dispel uncertainty about a new idea. Rogers proposed that the trialability of an innovation, as perceived by individuals, is positively related to its rate of adoption.

The final attribute of innovations is that of observability. Observability "is the degree to which the results of an innovation are visible to others" (Rogers, 2003, p. 258). Some innovations are easily observed, such as computer technology use. Rogers suggested that the observability of an innovation is positively related to its rate of adoption.

Rogers' (2003) diffusion of innovations theory has been used to focus research in many fields of study. Stewart (2000) and Dooley (1999) noted that this theory has been used in political science, communications, history, public health economics, technology, and education. Medlin (2001) and Parisot (1995) have suggested that Rogers' diffusion of innovations theory is the most appropriate theory for the investigation of technology use in educational environments. Medlin and Zakaria (2001) have used this theory in research focused on the adoption of

computers in lesson planning and classroom instruction. It is significant to note that even Rogers used the terms *innovation* and *technology* synonymously.

Technology Use in Education

Computer technology has complicated the teaching-learning methodology in the classroom and challenges the twenty-first century educational leaders and teachers. This technology use requires a shift from instructivist to constructivist philosophies of learning. The instructivist view is exhibited by the dispensing of information to the student through a lecture format. This theory views the student as a passive learner. In the constructivist learning theory, the learner constructs new knowledge through a process of analyzing new information and comparing it to previous knowledge. The constructivist theory is student-centered rather than teacher-centered (L. Campbell, Flageolle, Griffith, & Wjcik, 2002).

As computer technology use in education is becoming a requirement of public policy, educational leaders should support the use of and communicate clear policies for teacher use of computer technology in the classroom. Additionally, teachers should have knowledge of and positive attitudes toward the use of computer technology. For the last decade, access to technology was limited due to incomplete computer networks. Thus, wiring schools became one of the nation's highest educational priorities (Afshari et al., 2009). Ten years of investments have greatly improved this situation. By 2005, 99% of schools with access to computers had Internet access, compared to only 35% of schools in 1994 (Parsad & Jones, 2005).

Additionally, according to the National Center for Education Statistics (Parsad & Jones, 2005), public schools have made progress in expanding Internet access in instructional rooms. In 1994, only 3% of public school instructional rooms had Internet access, compared to 93% in

2003. By 2005, the student-to-computer ratio went from 12 to 1 to 4.4 to1 (Parsad & Jones, 2005).

Technologies available in schools today range from basic tool-based applications such as Microsoft Word to more sophisticated technologies such as online repositories for scientific data, primary historical documents, and hand-held computers. Each of these technologies can play a different role in the teaching-learning process (Prensky, 2005).

Teachers use computers in different ways to promote learning in the classroom. The primary form of student learning from computers uses discreet educational programs such as integrated learning systems, computer assisted instruction, and computer-based instruction (Murphy et al., 2001). These applications are the most widely available software packages using educational technology in schools today.

According to Murphy et al. (2001), teachers use computers in the classroom to supplement instruction, introduce topics, provide a means for self-study, and offer opportunities to learn concepts otherwise inaccessible to students. The teachers view computers as a medium for learning rather than as tools that can support further learning. Because access to computer technology is increasingly centered on the learner's experience, teachers can capitalize on this innovation to enhance the learning process.

Technology Infrastructure

The Milken/ISTE Report of 2000 found that the computer technology infrastructure (computer networks) of schools has increased more quickly than has the ability of teachers to incorporate new technology into teaching and learning (Milken/ISTE, 2000). A survey was developed in collaboration with the International Society for Technology in Society (ISTE Nets Project, 2000-2002) to assess the baseline of technology infrastructure and use in schools,

colleges, and departments of education in the United States. The results of this survey showed that the technology infrastructure may be adequate but that many teachers do not use it regularly. This survey also showed that deficiencies in the computer networks may be a limitation to computer integration in the classroom (Milken/ISTE, 2000).

The lack of a computer network has been identified as a limitation to teacher use of computer technology. Richardson (2000) conducted a survey of one Australian school that provided teachers with notebook computers and their own web sites. The results of this study showed that many teachers integrated this technology into their teaching and learning processes. Richardson concluded that hardware, software, and network infrastructure must be available to integrate computer technology in lesson preparation and delivery.

Grove et al. (2004) conducted a qualitative study of 16 teachers in Washington, DC. They found that, to support student-centered lessons using technology, a viable computer network and on-site support were essential. This on-site support should include mentoring of teachers in the use of available computer technology.

At the global level, several studies have shown that there is a lack of available computer resources. Albirini (2006), in a study of Syrian teachers, found that a lack of computers in the schools affected teachers' use of computer technology for lesson preparation and delivery. Globally, lack of computer availability has been identified as a barrier to technology adoption and integration by teachers (Pelgrum, 2001). Mumtaz (2000) also stated that lack of funds to obtain hardware and software for the classroom is one of the main reasons that teachers do not use technology in their classrooms.

Teacher Education in Technology

There are currently few teacher education programs that model instructional methods for integrating computer technology (Shelley et al., 1999). Because teacher knowledge is a critical component, teacher education programs should integrate computer technology use into the curriculum. Knowledge attained in formal education courses may affect teacher use of computer technology for lesson preparation and lesson delivery in the classroom.

Most faculty professional development related to computer integration in schools and school districts is held in short workshops with limited support and follow-up for integration (Hargreaves, 2005). Wetzel (2002) found that many teachers use computer technology in their personal lives. However, this personal use of technology does not transfer into the classroom. For this technology to be integrated by teachers in education, teacher education must become a systematic learning effort as part of professional development. A learning plan must be initiated and implemented by educational leaders, using a collaborative model.

Atkins and Vasu (2000) created a staff development model to address teacher use of technology in the classroom. The model has three goals for staff development. The first goal states that teachers will use technology to plan and deliver lessons that are based on curriculum, relevant to the learners and based on principles of effective teaching and learning. The second goal explains that teachers will use technology where appropriate and support learner expression. The third goal requires that teachers will locate, evaluate, and select appropriate resources for the content area and target student grade levels. This model meets the recommendation that infusion of technology should not be taught in a stand-alone course (Handler, 1993).

For the past 20 years, there has been an evolution of the integration of computer technology into curricula, with the intent of positively influencing teaching and learning (Dias &

Atkinson, 2001). There has been an increase in accessibility to computers in educational settings and a rapid development of interactive learning software. Despite this increase in computer availability, teacher use in lesson planning and delivery remains inconsistent.

Flanagan and Jacobsen (2003) suggested that technology integration is meant to be implemented cross curricula rather than as a separate course or topic. Computer technology should be used as a tool to support the educational objectives and educational program outcomes. Some of the ways in which computer technology can be used in curricula delivery include searching for and assessing information, cooperation, communication, and problem solving. These activities are important in the preparation of children for the knowledge society (Drent & Meelissen, 2007).

According to Dooling (2000), although there have been many efforts to acquire computer hardware for use in K–12 schools, there has been much less success in identifying how computers can be used for teaching and learning. Computer technology may facilitate independent self-paced student learning; however, this cannot be optimized if there is no shift in the learning and teaching paradigm (Howland & Wedman, 2004). Both educational leaders and teachers play an important role in promoting this shift.

The Role of Educational Leaders

Educational leaders influence the successful integration of technology in the classroom (Byrom, 1998). To be successful, they must become change agents, creating a culture whereby teachers use computer technology to prepare and deliver lessons. Essential in this process, educational leaders must understand the pedagogical, psychological, and cognitive barriers to the use of computer technology for lesson preparation and delivery (Benzie, 1995). They also must

be aware of the impact of policies, leadership, computer network infrastructure, and teacher attributes on the use of computer technology in the classroom.

Educational leaders must be cognizant of the national and local educational requirements related to the integration of technology in education. For example, the NCLB Act (2002) required technological literacy for students. This legislation also stressed standardized test results as a measurement for student achievement and a gauge for judging the quality of schools and educators. Therefore, efforts to integrate technology into schools and classrooms must not only acknowledge but also provide evidence that technology assists in meeting accountability demands.

In addition to being aware of national, state, and local standards, educational leaders must be informed of the global initiatives influencing technology in education. Performance of U.S. students on international assessments (National Center for Education Statistics, 2001) and concerns about the relative competitiveness of the U.S. labor force have resulted in examination of our current educational system by many stakeholders. Government, business, and educational leaders have examined the effectiveness of the U.S. educational system in relation to the technological and business changes brought about by computer technology use and the resulting globalization (Ridgeway, McCusker, & Pead, 2004).

Educational leaders are accountable and responsible for establishing a policy and a plan for the integration of technology in schools. This system should be based on a well-defined mission that describes computer technology's place in education. The absence of a systematic and planning strategy can hamper the integration of computers in the classroom (Cuban, 2001).

Anderson and Dexter (2000) have noted that a school leader's computer technology vision is essential to effective technology integration in the classroom. This vision should not be

created from a top-down process but, rather, from contributions from all of the stakeholders in the school. These stakeholders should include educational leaders, computer technology experts, teachers, parents, students, and the community.

Educational leaders should collaborate with cross-disciplinary groups of teachers and technology coordinators to develop a technology integration plan. This plan should enumerate how teachers are expected to integrate computer technology in their lesson preparation and delivery. It should include well-constructed mission and vision statements, an integration plan, an up-to-date hardware infrastructure, teacher training and education, and leader support (Anderson & Dexter, 2000).

Gulbahar (2005) stated that providing up-to-date hardware and software resources are key components to the diffusion of computer technology. Educational leaders must ensure that there is appropriate funding for both the technology and resources necessary to promote integration into the classroom. They can accomplish this through the budget process and by applying for external funding.

Leaders also must ensure that teachers have the time to experiment and interact with computer technology. Mumtaz (2000) stated that lack of time is a factor that hampers the implementation of computer technology in schools and suggested that release time and scheduled time be made available to the teachers. A study conducted by the National Center for Educational Statistics (2001) further supported this assertion and concluded that 82% of the teacher participants reported that lack of release time was the most significant factor that prevented them from using computers in their classrooms and for lesson preparation.

Educational leaders play an essential role is providing technical support to teachers. In a study by Butler and Sellbom (2002), an identified barrier to adopting the innovation of computer

technology by teachers was the lack of technical computer support. This support was identified as having a high-level technology coordinator as well as technical support personnel.

Providing a computer technology coordinator or director in each school district has been identified as a successful strategy to assure administrative and pedagogical resources for the teachers. The coordinator or director can advise teachers on computer technology solutions. They also can provide assistance with teaching and learning problems, help teachers acquire technology resources, conduct training needs assessments of teachers related to computer technology, and advise them on professional development (Howland & Wedman, 2004).

The technology coordinator or director also may coordinate technology assistants who ensure computer technology functionality. The availability of technical assistants may help teachers use computers efficiently in the classroom. This availability of support personnel may alleviate teacher anxiety in the use of computer technology in the event of a hardware malfunction.

Senior leadership plays an important role in establishing computer technology use as part of the school culture (Anderson & Dexter, 2000). Leadership is a predictor of computer technology integration, as it promotes the use of computer technology at a strategic and action level (Baylor & Ritchie, 2002). To promote computer technology in schools, Baylor and Ritchie suggested that school leaders should adopt strategies that make computer technology integral to the daily activities of the teachers.

School leaders, such as principals, also should use computer technology in their daily activities and be role models for their teachers and students (Howland & Wedman, 2004). They should collaborate with teachers in the use of technology to foster student learning and

assessment. Active engagement in technology by administrators as well as teachers promotes its integration in the classroom.

The educational leader must help create a school culture that supports and values the use of computer technology by teachers. School culture is important to the integration of computer technology in schools (Tearle, 2003). School culture represents the basic assumptions, norms, and values, as well as cultural artifacts shared by school members (Maslowski, 2001).

Albirini (2006) further supported the importance of school culture to the integration of computer technology in the classroom. He suggested that a mismatch of values between the school culture and the use of computer technology influences teacher acceptance and use in the classroom. He further stated that teachers who have positive perceptions of cultural relevance regarding computer technology will use it in their lesson preparation and delivery (Albirini, 2006).

Leaders in education must ensure that there is adequate professional development of teachers in the use of computer technology. Baylor and Ritchie (2002) examined teacher use of technology and found that professional development influenced the frequency of use of computer technology in the classroom. They found that the most effective professional development activities incorporated the opportunity to gain hands-on experience with the various types of computers and software.

Educational leaders must provide professional development for teachers that focus on the integration of computer technology into the curriculum. Too often, professional development of teachers in technology has focused on teaching about the technology and providing basic computer literacy skills instead of focusing on teaching with technology (Schaffer & Richardson,

2004). Additionally, principals as well as teachers should be provided with the methodology of using computer technology in lesson preparation and delivery.

Educational leaders are a formal force in the integration of technology in education. They not only convey the vision, mission, and technology integration plan, but they are responsible for its effective implementation. To fully support the teachers in the implementation of technology use, the educational leaders must understand teacher attributes as they relate to computer technology. The teacher is ultimately responsible for using technology in lesson preparation and delivery. The leaders should be supporters in this endeavor.

Teacher Attributes

Studies have shown that the primary determinant of whether technology succeeds or fails in the classroom is the teacher (Hargrave & Hsu, 2000; Milbrath & Kinzie, 2000; Pilus, 1995). The majority of studies on teacher use of computer technology in education explore the following issues: what teachers should be learning in technology courses (Hargrave & Hsu, 2000), teachers' attitudes toward computer technology (Atkins & Vasu, 2000), and how teachers think about and use computers in the classroom (Ertmer, Addison, Lane, Ross, & Woods, 1999; Pilus, 1995).

Hsu, Huang, and Wu (2007) studied factors relating to junior high school teacher computer-based instructional practices. They surveyed 600 junior high school teachers in Taiwan. The results indicated that teaching seniority had a significant impact on teacher computer use in the classroom. They found that teacher belief in the effectiveness of computer-based instruction was the biggest predictor of teacher successful implementation of this technology in the classroom.

Another factor that has been researched is gender with respect to computer-learning technologies. According to J. R. Campbell (2000), females learn best when interacting with other human beings, and males learn best through the use of symbols. Since computer-based technology is based on symbols, it may be more easily learned by males. Cooper (2006) concluded that females are at a disadvantage relative to men when using computers and computer-assisted software. He found that the major factor of computer anxiety was greater in females.

Liff and Shepherd (2004) found that the gender divide was closing among males and females who use the Internet and other computer mediums. Roy and Chi (2003) examined gender differences in students searching the Web. This study found that computer search behavior differed between males and females. Boys and girls tended to use different search patterns of searching but, nonetheless, they obtained similar outcomes.

In an exploratory study on the effects of gender and learning styles on computer programming performance, Lau and Yuen (2009) found that no gender differences existed after controlling for the effects of student ability. Academic ability was found to have an effect on student learning of computer programming. In addition, sequential learners performed better than random learners. Therefore, learning styles were found to be more significant than gender.

Teaching Experience and Computer Use

Years of teaching has been examined in relation to computer use in the classroom. In a study of first-year teachers in the United States, Shelley et al. (1999) found that teachers reported a positive experience with technology in their pre-service teacher education, yet did not use technology in the classroom. This study showed that the complexities of surviving the first year of teaching with new content, materials, resources, and classroom management was found to

leave little time and energy for using computer technology in lesson preparation and delivery (Shelley et al., 1999).

However, it is important to note that, in a report by the National Center for Educational Statistics (2001), teachers with fewer years of experience were more likely to use computer technology than teachers with more years of experience. This study found that teachers with three years or less teaching experience reported using computers 48% of the time; teachers with 4-9 years' experience, 45% of the time; and those with 10–19 years of experience, 47% of the time. Teachers with 20-plus years of experience reported using computers only 33% of the time. Therefore, one of the factors that may determine the extent to which teachers use computer technology may be the number of years they have been teaching.

Teacher Age and Computer Use

Teacher age also has been studied in relation to technology use. Albirini (2006) found that age was not a factor in relation to teacher attitudes related to computer technology use in the classroom. However, Roberts, Hutchinson, and Little (2003) studied teacher use of technology in the classroom in relation to the number of years that they completed their teacher education. They found that the probability that teachers would use computer technology in the classroom was influenced by the number of years they completed their teacher education (Roberts et al., 2003). Teachers who were educated 20 years or more were least likely to use computers in the classroom. They also concluded that these teachers were also older in age and that they were educated by people who became educators before the arrival of computers (Roberts et al., 2003).

Bauer and Kenton (2005) carried out a qualitative study to examine the classroom practice of 30 identified technologically savvy teachers who reportedly used computer technology in their lesson preparation and delivery. More than age, the results of the study

suggest that the teachers who were highly educated and skilled with technology were innovative and able to overcome obstacles but did not integrate technology on a consistent basis as a teaching and learning tool. Teachers in the study did not have enough planning time devoted to planning for technology integration into their lesson presentation. They also found that outdated hardware, lack of appropriate software, technical difficulties, and student skill levels influenced teachers' use of computer technology in the classroom.

Subject and Grade Level Taught and Computer Use

Another area of importance for teachers' use of computer technology is subject and grade level taught. In a study of teacher technology use, Barron et al. (2003) found that high school science teachers used computer technology more than any other subject area teachers in secondary education. Their study also found that elementary school teachers were nearly twice as likely to use computers as a decision-making or problem-solving tool as were high school teachers. This study also found that elementary teachers used technology more as a means of communication than did middle and high school teachers.

Teacher Attitudes Related to Computer Technology

Teacher attitudes related to computer technology have been found to affect teacher use of computer technology in lesson preparation and delivery. In a study of 210 teachers in the Netherlands, Drent and Meelissen (2007) found that a positive attitude toward computer technology has a positive influence on the innovative use of computer technology in the classroom. They found that teacher attitude toward computers contributed more in explaining computer technology use in the classroom than did the pedagogical approach or computer experience of the teacher (Drent & Meelissen, 2007).

The attitudes of teachers have been found to be major predictors of the use of new technologies in instructional settings (Almusalam, 2001). Vannatta and Fordham (2004), in a survey design using the teacher attribute survey for 177 teachers in Ohio, identified attributes such as teacher openness to change as a predictor of computer technology use. This study also identified teacher self-efficacy as affecting classroom technology use.

Kluever, Green, Hoffman, Lam, and Swearingen (1994) suggested that teacher attitudes toward computers affect both computer use in the classroom and their likelihood of benefiting from training. They further stated that positive attitudes encourage the less technologically capable teachers to learn the necessary skills for integration of computer technology in the classroom. Negative computer attitudes were associated with less skill in computer use, thus, the less likely use of computer technology for lesson preparation and delivery.

For teachers to use computer technology, they need to possess a positive attitude toward this innovation. A positive attitude is promoted when teachers are comfortable with technology and knowledgeable on its use. Christensen (2002) studied sixty K–5 grade teachers in Texas and concluded that teachers' attitudes toward computers are an important factor in affecting the quality of student experience with computers.

Levin and Wadmany (2006/2007), in an exploratory, longitudinal study, examined the evolution of teacher beliefs on learning and teaching in the context of a technology-based classroom environment. They examined teachers in six 4–6 grade classrooms. They used multiple research tools which included interviews, questionnaires, and observations. The study concluded that it is easier to change teacher classroom practices with technology than to change their beliefs about technology.

The U.S. Department of Education 2000 Report (2004) on teacher use of technology reviewed research on teachers' views and attitudes about the use of technology in their classrooms. This research indicated that teachers' attitudes about using technology in the educational setting were affected by the environment in which they worked. This data further showed that difficulties with hardware, technical problems, and time constraints discouraged the integration of technology into the curriculum (Smeardon & Cronen, 2000).

Wozney, Abrani, and Vantesh (2006) examined teacher attitudes and current computer technology practices among 764 elementary and secondary teachers from private and public schools in Quebec. They surveyed the teachers using the Technology Implementation Questionnaire. The results of this study suggest that perceived value of computer use in the classroom was the most significant predictor of teacher use of computers in the classroom.

How teachers view their role influences how they teach with technology. Teachers' beliefs about classroom practices appear to shape their use of technology in the classroom. Changing teaching methodology requires more than just time to investigate new methods. Leaving the comfort zone is uncomfortable, if not somewhat scary (Titterington, 2000).

Teachers' beliefs about education and classroom practice appear to shape their goals for technology use in the classroom (Titterington, 2000). Beliefs about teaching, beliefs about computers, established classroom practices, and unwillingness to change influence teachers' use of technology. Teachers' resistance to change is primarily due to concerns regarding the influence of instructional technology integration on their beliefs and values (Wetzel, 2002).

Compatibility with Current Teacher Traditional Teaching Methods

Integration of computer technology in education requires that teachers make pedagogical and curriculum changes (Wetzel, 2002). Ryba and Brown (2000) found that teachers who are proficient computer-users establish a socially interactive and reflective community of practice within their classrooms. They have a strong commitment to learner-centered approaches in which the students take responsibility for self-regulation of their learning and behavior (Ryba & Brown, 2000).

Teachers who are proficient in computer technology integration in the classroom do not use traditional teaching methods. Instead, they are creating structure, providing advice, and monitoring progress as the "guide from the side" (Kozma, 2003). They have shifted from a teacher-centered (instructivist) teaching approach to a student-centered (constructivist) learning approach.

Due to the integration of computer technology, the role of the teacher is being transformed from the traditional dispenser of knowledge to that of a facilitator of learning. The teacher now provides information in the context of a rich learning environment in which the student is an active learner. The teacher's role is to plan for and manage the computer-learning environment and to facilitate and guide the learning that goes on within it (Lumpe & Chambers, 2001).

Computer technology has altered how teachers run their classrooms. In this new environment, the teacher's roles include (a) planner, (b) manager, (c) facilitator, (d) guide, and (e) participant (Ryba & Anderson, 1993). Teachers must use computers effectively in the general subject/content areas to allow students to learn how to apply computer skills in meaningful ways.

In a survey research study that examined the teaching practices of 25 exemplary technology-using teachers in the Midwest, Ertmer, Ottenbreit-Leftwich, and York (2006) found that these teachers were willing to shift away from the classroom practice of teacher-centered lessons. The teachers in this study were found to be willing to take risks using trial and error. These teachers found technology to be a tool for achieving their vision of teaching and learning. It is important to note, however, that this study had a small number of participants from a large school system in a fairly small geographic region.

An example of a new teaching method that integrates technology in education is the teacher-facilitator approach. Learners access and utilize technology to assist them in the inquiry process. Teachers present an assignment, give instructions, and provide a brief demonstration. Students then work at their own pace to complete assignments (Wetzel, 2002).

Integration of technology in education requires the use of teaching strategies that expand traditional methods. Implications for pre-service teacher education programs are significant. These programs should model the new pedagogies and tools for learning with the goal of enhancing the teaching-learning processes (Afshari et al., 2009). Future teachers will then be able to understand and use the new technologies in the classroom.

Teacher Perception and the Impact of Computer Technology on Student Achievement

Teacher perception on the impact of computer technology use on student achievement is another factor that may influence teacher use of technology in lesson preparation and delivery. In a meta-analysis review of research conducted between 1993 and 2000 on the effectiveness of discrete educational software (DES) programs, Murphy et al. (2001) found evidence of a positive association between use of this software and student achievement in reading and mathematics.

They further found that students in the early grades, from pre-K to third grade, and in the middle school grades benefit most from this software application for reading instruction.

O'Dwyer, Bebell, Russell, and Tucker-Seeley (2005) found, while controlling for both prior achievement and socio-economic status, that fourth grade students who reported greater frequency of technology use at school to edit papers were more likely to have higher total English/Language Arts test scores and higher writing scores on the fourth grade Massachusetts Comprehensive Assessment System English/Language Arts Test. This study demonstrates a link between computer technology use and achievement in standardized testing.

In Michigan, an initiative that provides middle school students and teachers with access to laptop computers has been found to improve student grades. This initiative also has been credited with improving motivation and discipline in classrooms across the state. Again, this initiative and its outcomes suggest a relationship between use of technology and student achievement.

Cavanaugh's (2004) analysis of 19 experimental and quasi-experimental studies on the effectiveness of interactive computer-based education found a positive effect on student achievement. It is significant to note that this effect was increased when computer education was combined with traditional classroom instruction.

While research that links the use of computer-based technology with student achievement is emergent, some research suggests a connection. Students who were enrolled in the Missouri technology integration initiative, scored higher on the Missouri assessment exams (Walsh & Podgursky, 2001). These findings also were consistent with students classified as having special needs. This initiative has since expanded to include other states, as well.

Hsu et al. (2007) conducted a study of a Web-based computer learning program with 40 first-year senior high students from a class in Taiwan. The purpose of the study was to analyze student achievement in scientific concepts and science process skills after they had completed Web-based lessons. The sample included 23 females and 17 males. A Web-based interactive learning environment was implemented for four lessons related to the science curriculum. The results of this study showed that the Web-based course helped students gain a better understanding of subject-related concepts and improved their science process skills.

Student achievement in the area of metacognitive awareness was investigated in relation to the effects of an asynchronous learning network (ALN). Metacognitive awareness refers to the student's being aware of how he or she learns (Michalsky, Mavarech, & Zion, 2007). This study included 202 tenth-grade students in Israel. One group of students studied under the ALN method, and one group studied in traditional face-to-face classroom environments. The results of this study indicated that the ALN students significantly outperformed the traditionally educated students in demonstrating metacognitive awareness. This is significant, as metacognitive awareness is essential in promoting inquiry learning.

Another factor that influences the impact of technology on student achievement is that changes in the classroom technologies correlate to changes in other educational factors, as well (Byrom, 1998). For example, teachers' perceptions of their students' capabilities have been found to shift markedly when technology is integrated into the classroom (Honey, Chang, Light, & Moeller, 2006). Teachers lecture less and act more like coaches; this methodology also may have a positive effect on student achievement (Tinzmann, 1998).

Since the NCLB (2002) legislation was enacted, there has been an increased focus on monitoring K–12 student achievement. One way in which computer technology has helped with

this monitoring is by providing teachers with a broad range of tools to collect and analyze student achievement data. This technology assists teachers in thinking more systematically about student achievement.

Conclusion

Human history has been characterized by many "ages." We identify periods by naming them. Thus, we use such terminology as the dark ages, the Middle Ages, the enlightenment, the Renaissance, the age of reason, the industrial revolution, and, more recently, the information age. Each period brings with it an identifier. Just as the previous ages had specific tools, advantages, or shortcomings, the current information age allows people to use a specific tool to enhance society. This tool is the computer and the surrounding network that supports such technologies. Computers have transformed how we learn, how we communicate with one another, and, essentially, how we live.

Traditionally, educators have used a lecture methodology to impart knowledge. With the advent of the computer and the Internet, this methodology has been reevaluated. Because today's students have been weaned on iPods, cell phones, laptops, and high-definition television, they are highly visual and learn differently than did former students. They can type at an early age, use computer applications to text, research school assignments, and listen to thousands of songs stored on a small device. It is clear that, for education to be effective in this "information age," computer technology must be welcomed into the school building and be utilized just as energetically as the teacher and the chalkboard. Public policy also has required educational leaders to embrace this new technology and support its incorporation into the curriculum.

NCLB (2002) and Race to the Top (American Recovery and Reinvestment Act, 2009) use federal funds to require changes in local school curricula. Each of these initiatives states that

computer technology must be utilized to improve the learning process. States have implemented the use of this technology by providing the network infrastructure and the computers. The federal government has provided funds to help states implement this new technology. Thus, the necessity of teacher use of computer technology for the preparation and delivery of lessons cannot be disputed.

It is noteworthy to mention that research on computer technology stems from the 1980s and is international in scope. This speaks to the validity of the new technology as well as the globalization of world societies. But merely to require its use in the classroom does not make it so. Teachers, the main component in computer technology adoption and use, must be influenced to accept this innovation. Studies suggest that leadership, teacher attributes, and attitudes influence the acceptance and the use of computer technology.

Rogers (2003), a prominent researcher in the field of innovation, stated that innovations are adopted over a period of time. According to Rogers, innovations have five distinct adopter categories: (a) innovators, (b) early adopters, (c) early majority, (d) later majority, and (e) later adopters. Because the diffusion of innovations theory has guided research in instructional technology, it was used as the theoretical framework for this study of computer technology use by teachers in lesson preparation and delivery.

Educational pedagogy has included many methodologies over the years. Currently, there is a move to structure the curriculum in a student-centered manner. Students are seen as integral to the learning process and, thus, become participants in their education. Computers facilitate student involvement and participation in this process.

Educational leadership is the most crucial aspect of teacher adoption and use of computer technology. A viable and efficient computer network must exist for students to become involved

in their education. Teachers must be educated in the use of computer technology in lesson preparation and delivery for effective implementation of computer technology.

Teacher attitudes and beliefs may contribute greatly to their computer technology use. If they see the computer as being a positive tool in lesson preparation and delivery, they will use it. Years spent teaching also affect teacher use of computer technology. The younger teachers, having spent more time experiencing the "new" technologies, may use computer technology in lesson preparation and delivery. A positive attitude greatly enhances computer use. Teachers' perceptions of computer use as being compatible with the previous methodologies allow teachers to use it in their classrooms.

Educational leaders play a pivotal role in teachers' implementation of computer technology. Some factors that influence computer use are extrinsic, such as the computer network, and some are intrinsic, such as teacher age and experience. Educational leaders may directly influence the extrinsic factors but also must be cognizant of the intrinsic factors that affect computer implementation. Effective budgeting may benefit the former, but teacher education may help teachers effectively implement computer technology for the preparation and delivery of lessons.

CHAPTER III

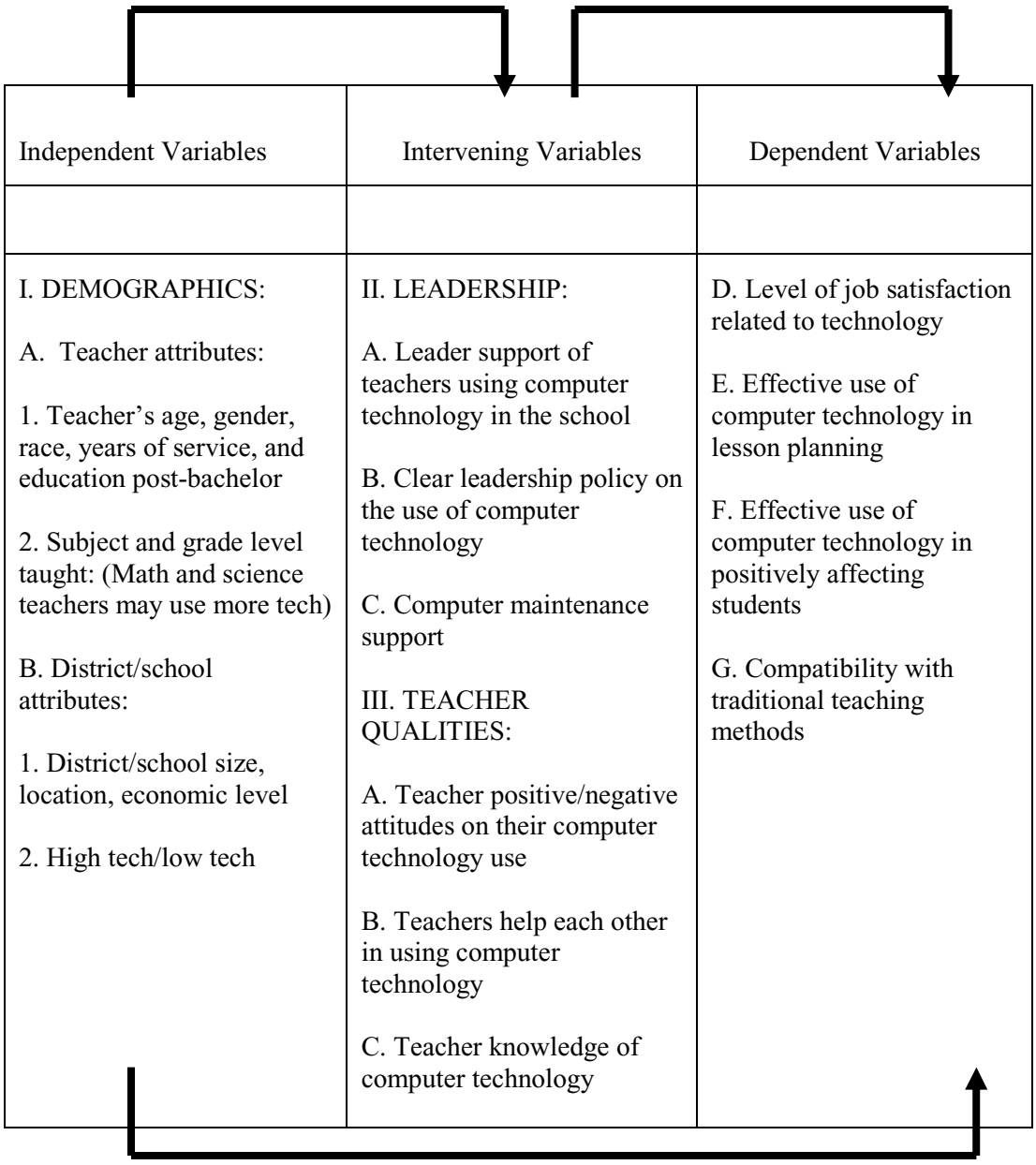
RESEARCH DESIGN AND METHODOLOGY

Overview

Since 2001, education has become the focus of the federal government by the enactment of the NCLB legislation (2002). Further, Race to the Top legislation (American Recovery and Reinvestment Act, 2009) gave financial rewards to states who adopted new standards. Both of these initiatives stressed the importance of using computer technology as a tool for lesson preparation and delivery. Educational leaders have attempted to implement computer technology in the classroom. However, studies have shown that the ultimate determinant of computer use is the teacher (Cuban, 2001; Ravitz et al., 2000).

Design

This study related the background of the teachers as it impacts computer technology use in the classroom. Teachers' perceived support from educational leaders as they communicate a clear mission, set policies for computer implementation, and supply an efficient infrastructure were examined. A survey instrument, Teacher Review and Assessment of Computer Technology (Appendix A), was created by the researcher. The questions in the instrument were organized into three categories. Category 1 asked who the respondents were. Category 2 addressed the level of support teachers feel they have. Category 3 explored the feelings and perceptions that teachers have toward computer technology. The research design is presented in Figure 1. Each of the variables is detailed below.



Independent Variables	Intervening Variables	Dependent Variables
I. DEMOGRAPHICS: A. Teacher attributes: 1. Teacher's age, gender, race, years of service, and education post-bachelor 2. Subject and grade level taught: (Math and science teachers may use more tech) B. District/school attributes: 1. District/school size, location, economic level 2. High tech/low tech	II. LEADERSHIP: A. Leader support of teachers using computer technology in the school B. Clear leadership policy on the use of computer technology C. Computer maintenance support III. TEACHER QUALITIES: A. Teacher positive/negative attitudes on their computer technology use B. Teachers help each other in using computer technology C. Teacher knowledge of computer technology	D. Level of job satisfaction related to technology E. Effective use of computer technology in lesson planning F. Effective use of computer technology in positively affecting students G. Compatibility with traditional teaching methods

Figure 1. *Design of the Study*

Independent Variables

The independent variables examined in this study included data from teachers, school, and district. In the survey, teachers provided information on age, gender, race, and their years of service and education post-baccalaureate. The school and district demographic information included the following: school and district size; level of technology (high tech or low tech);

economic level of the student population; location (urban, suburban, rural); and level of school (elementary, middle, high school).

Intervening Variables

This study focused on six intervening variables. First, perceived leader support of teachers who use computer technology was addressed. Positive support from leaders could make teachers more comfortable and allow them to use computer technology in lesson preparation and delivery. Second, clear leadership policies on the use of computer technology influence the effective use of computer technology in lesson preparation and delivery. Third, computer maintenance support helps teachers with issues that affect computer use in lesson preparation and delivery. The hardware portion of computer technology in the classroom should be in working order and be up to current standards. Fourth, teachers' attitudes toward technology revealed their adoption or rejection. If they adopt the innovation, this could influence positively their ultimate use of computer technology. Fifth, colleagues' use of computer technology could influence teacher use of technology. Finally, teachers' knowledge of computer technology could affect their use of technology in the educational setting.

Dependent Variables

In research studies, the dependent variables are affected by the independent variables (demographics) and/or the intervening variables (leadership practices and teacher qualities). "In a hypothesized cause-and-effect relationship, the dependent variable is the effect" (Gall, Gall, & Borg, 2007, p. 637). In this study, the identified dependent variables (outcomes) are teacher job satisfaction related to computer technology, effective use of computer technology in benefitting students, effective use of computer technology in lesson preparation, and compatibility with the use of computer technology and traditional (teacher-centered) teaching methodology. Statistical

analysis determined to what extent there was a significant relationship between each of the variables in this study.

Research Questions

Using Rogers' (2003) diffusion of innovations theory, the researcher created the following research questions to guide this study.

1. To what extent do teacher attributes (consisting of age, race, years of service and education post-baccalaureate degree, subject and grade level taught) affect their use of computer technology in lesson planning and delivery?
2. To what extent do school and district attributes (consisting of district/school size, economic level, and high/low tech environment) affect their use of computer technology in their lesson planning and delivery?
3. To what extent do teachers' perceived leadership support (consisting of clear policies on the use of computer technology and computer maintenance support) relate to their use of computer technology in lesson planning and delivery?
4. To what extent do teacher qualities (consisting of teacher attitudes on computer technology use, colleague computer use, and teacher knowledge of computer technology) affect their use of computer technology in lesson planning and delivery?
5. To what extent do teacher qualities (consisting of attitudes and colleague use and knowledge of computer technology) affect their perceived compatibility with traditional teaching methods?
6. Are there specific leadership practices (consisting of leader support, clear leadership policy, and maintenance support of computer technology) related to technology that influence the job satisfaction of teachers?

7. Are there teacher qualities (consisting of teacher attitudes, teachers helping each other with computer technology, and teacher knowledge) related to the level of teacher perceived job satisfaction related to computer technology?
8. Are there specific leadership practices (consisting of leader support, clear policies, and maintenance support of technology) and effective use of computer technology in positively affecting students?
9. Are there specific teacher qualities (consisting of teacher attitudes, teachers helping each other with computer technology, and teacher knowledge) and effective use of computer technology in positively affecting students?

Null Hypotheses

The following hypotheses were tested to determine whether there was a significant relationship between leadership (support and clear policies), teacher attributes (age, gender, level of education) school/district attributes (size, economic level, high/low tech) teacher qualities (attitudes on computer technology use, teacher knowledge of technology, and colleague use of technology) and teacher use of computer technology, job satisfaction, and compatibility of computer technology use and traditional teaching methods.

H1. There is no difference based on teacher attributes (age, years of service, and education post-baccalaureate degree and grade level) and teacher level of use of computer technology in lesson planning and delivery.

H2. There is no difference between school/district attributes (school/district size, economic level, and high/low tech) and teacher level of use of technology for lesson planning and delivery.

H3. There is no relationship between leadership (consisting of leader support, clear policies, and maintenance support of technology) and teacher level of use of computer technology for lesson preparation and delivery.

H4. There is no relationship between teachers' qualities (consisting of positive/negative attitudes on technology use and colleague use and knowledge of computer technology) and their level of use of computer technology for lesson planning and delivery.

H5. There is no relationship between teachers' qualities (consisting of positive/negative attitudes on computer technology use and colleague use and knowledge of technology) and perceived level of compatibility with traditional teaching methods.

H6. There is no relationship between leadership (consisting of leader support, clear policies, and maintenance support of technology) and the level of teacher-perceived job satisfaction related to computer technology.

H7. There is no relationship between teacher qualities (consisting of teacher attitudes, teachers helping each other with computer technology, and teacher knowledge) and the level of teacher-perceived job satisfaction related to computer technology.

H8. There is no relationship between leadership (consisting of leader support, clear policies, and maintenance support of technology) and effective use of computer technology in positively affecting students.

H9. There is no relationship between teacher qualities (consisting of teacher attitudes, teachers helping each other with computer technology, and teacher knowledge) and effective use of computer technology in positively affecting students.

Method

The researcher employed a quantitative survey research method to identify and compare variables necessary to analyze teacher perception on leadership and teachers' attributes and the use of computer technology in public schools. Survey research was used primarily to attain information on the perceptions, attitudes, and opinions of the sample. The data obtained from the surveys were analyzed using statistical measures to determine the significance of relationships of variables. The researcher employed a cross-sectional survey of public school teachers to focus this research. Teachers from elementary, middle and high schools were surveyed. Data from these surveys were analyzed using statistical methods to determine how leader support and teacher attitudes and perceptions toward computer technology affect teachers' use of computer technology. Information on the sample, instrumentation, and statistical analyses are detailed in the following section.

Sample

The population for this study included elementary, middle, and high school teachers who worked in New York State; however, a convenience sample was used to select participating teachers. The sample consisted of 120 school teachers from school districts in New York State that were identified as either high-tech or low-tech districts. High-tech districts are defined as districts that have middle to high economic levels and have a low percentage of students who are eligible for free or reduced-price breakfast. Low-tech districts are defined as districts that have a low economic level and have a high percentage of students who are eligible for free or reduced-price breakfast.

Teachers were sent the electronic version of the Teacher Review and Assessment of Computer Technology survey with a letter (Appendix B) that explained the purpose of the study,

how the survey data would be used, and the anonymity and security of the survey data. Participants were asked to acknowledge the letter of informed consent (Appendix C). Additionally, permission was procured from Fordham University's Institutional Review Board to conduct the study (Appendix D). The sample schools in the study ranged in size and demographics, and only schools from New York State were included.

Instrumentation

The TRACT survey was developed by the researcher. It was used to measure teacher perception of job satisfaction related to computer technology, effective uses of computer technology in lesson preparation, compatibility with traditional teaching methodology, and positive effect on students.

The Teacher Review and Assessment Computer (TRACT) Survey

The TRACT survey, consisting of 36 questions, was designed to measure teachers' perceptions and attitudes toward computer use in lesson preparation and delivery. The TRACT survey had three sections. Section 1 addressed teacher demographics. Section 2 addressed teachers' perceived level of support from their leaders. Section 3 addressed teacher satisfaction and perceived effectiveness with using computer technology. The TRACT survey used a 5-point Likert-scale perceptions survey, ranging from 1 = Almost Never to 5 = Almost Always.

Reliability and Validity of the TRACT Survey

The TRACT survey was pilot-tested using a scramble method. The researcher used a scramble to identify internal reliability at level .70 and above. Reliability was tested and confirmed, whereby a number of educators matched items in the survey with topic headings. This tool was copyrighted by the researcher. Validity is the extent to which the survey measures

what it was created to measure. Reliability is the extent to which an instrument is free from measurement errors and is consistent in measurement (Muijs, 2004).

The TRACT survey instrument was designed to measure the general perceptions of and use by teachers of computer technology in K–12 schools. Specifically, the survey measured the level of job satisfaction related to computer technology, effective uses of computer technology in lesson planning, positive effect on students, and compatibility with traditional teaching methods.

To test the TRACT survey for content validity and reliability, the researcher asked a panel of doctoral students and practicing educators familiar with the roles and responsibilities of teachers and their use of technology to sort each of the randomly scrambled survey items into the four sub-categories of: job satisfaction, effective use of computer technology, positive effect on students, and compatibility with traditional teaching methodology.

According to Latham and Wexley (1981), an item is considered to have content validity if 70% of the panel members sort the item into the correct sub-category. Reliability will be evident when an item on the survey has a coefficient of .70 or higher. Cronbach's alpha was used to test the internal validity of the TRACT survey.

Analysis

Statistical analyses were performed on the data collected from the surveys. The results from the analyses assisted the researcher in reaching conclusions on a variety of relationships and differences among the variables. Following data collection, descriptive statistics were used to determine the frequency of the independent variables in the study, for example, the percentage of male teachers versus female teachers and job satisfaction related to technology. The mean, median, mode, range, variance, and standard deviation were calculated as needed.

Comparative analyses were used to identify significant differences among groups in the study. While differences may appear to exist between groups, the statistical significance of the differences was tested. For example, statistical procedures such as *t* tests were used to determine whether female teachers were more satisfied than were male teachers, or whether more experienced teachers were less satisfied than were teachers with less experience. To analyze the difference in the means of two variables, the researcher used *t* tests.

Correlation analysis was used to measure the relationships among variables as well as the direction and magnitude of correlations among any set of two or more variables. Regression analysis was used to determine whether any combination of the intervening variables were significant predictors of the variance in any of the dependent variables, such as whether a teacher's reported degree of computer technology support in his or her school will increase his or her use of computer technology for lesson planning and delivery.

The use of statistical procedures to analyze the data assisted the researcher in reaching conclusions on the frequency, relationships, and predictive factors associated with each set of variables. This information was valuable for determining the significance of each of the hypotheses in this study. Furthermore, statistically significant conclusions were formulated to inform practitioners, such as teachers and educational leaders, of how their perceptions and behaviors related to technology affect the use of computer technology in positively benefitting students and teachers.

While research exists on the use of computer technology in education, more research is needed to identify specific factors that influence teacher job satisfaction related to computer technology use, effective use of computer technology in lesson preparation and delivery, positive student benefits, and compatibility with traditional teaching methodology. In this study, teachers

were surveyed to determine the factors related to the use of computer technology in education using Rogers' (2003) diffusion of innovations theory. In the survey, teachers rated the above factors as they relate to computer technology use. The results of this study may provide educational leaders with valuable data on how their leadership could promote the efficient use of computer technology for lesson preparation and delivery.

Chapter IV

FINDINGS

Introduction

During the past decade, public education has expended a considerable amount of resources on computer-based hardware and software. For these expenditures to have been justified, educational leaders should support teachers' use of technology through clear policies and computer maintenance support so that teachers can adopt the innovation of computer technology to plan and deliver lessons. While most research focuses on the use of technology in education, little focuses on teachers' perceptions of leadership support and teachers' beliefs/attitudes regarding computer technology use in education. This study examined teachers' perceptions on leadership, teacher attributes, job satisfaction related to computer technology use, effective use of computer technology, effective use of computer technology that positively affects students, and compatibility of computer technology use with traditional teaching methods.

Chapter IV presents the findings of research on teachers' perceptions in a region of New York State. Teachers were surveyed to determine their perceptions of leader support based on Rogers' diffusion of innovations theory (2003) as well as their level of job satisfaction, effective use of computer technology, positive impact on students, and compatibility with traditional teaching methods. Nine research questions were addressed, and nine hypotheses were tested to provide the educational community with more information about the impact that educational leadership and teacher attitudes/attributes have on computer technology use for lesson preparation and delivery.

This chapter contains five main sections. The first section provides descriptive information on the demographical data collected on the teachers and their districts/schools. The second section presents each of the demographical groupings of the sample to determine whether there were any significant differences among groups, based on each of the intervening and dependent variables. To measure the difference between the means of two demographic groups, the researcher used a statistical test called a *t* test (Muijs, 2004).

The third section presents a comparative analysis of the various teacher and school demographical groupings used to determine any significant differences between these groups as they relate to each of the independent and dependent variables, using *t* tests. The fourth section presents the findings from testing each of the hypotheses. Correlation analysis was used to measure the relationships between the independent and dependent variables as well as the direction, magnitude, and statistical significance of these correlations. The fifth section contains the results of regression analyses of the variables used to determine whether any combinations of variables are significant predictors of the variance of the dependent variables.

The following research questions guided this study using Rogers' (2003) theoretical framework for diffusion of innovations.

Research Questions

1. To what extent do teacher attributes (consisting of age, race, years of service and education post-baccalaureate degree, and subject and grade level taught) affect their use of computer technology in lesson planning and delivery?
2. To what extent do school and district attributes (consisting of district/school size, economic level, and high/low tech environment) affect their use of computer technology in their lesson preparation and delivery?

3. To what extent do teachers' perceived leadership support (consisting of clear policies on the use of computer technology and computer maintenance support) relate to their use of computer technology in lesson preparation and delivery?
4. To what extent do teacher qualities (consisting of teacher attitudes on computer technology use, colleague computer use, and teacher knowledge of computer technology) affect their use of computer technology in lesson preparation and delivery?
5. To what extent do teacher qualities (consisting of attitudes and colleague use and knowledge of computer technology) affect their perceived compatibility with traditional teaching methods?
6. Are there specific leadership practices (consisting of leader support, clear leadership policy, and maintenance support of computer technology) related to technology that influence the job satisfaction of teachers?
7. Are there teacher qualities (consisting of teacher attitudes, teachers helping each other with computer technology, and teacher knowledge) related to the level of teacher perceived job satisfaction related to computer technology?
8. Are there specific leadership practices (consisting of leader support, clear policies, and maintenance support of technology) and effective use of computer technology in positively affecting students?
9. Are there specific teacher qualities (consisting of teacher attitudes, teachers helping each other with computer technology, and teacher knowledge) and effective use of computer technology in positively affecting students?

Null Hypotheses

Nine hypotheses were tested to determine whether there was a significant difference between leadership (support and clear policies), teacher attributes (age, gender, grade level taught, and level of education) school/district attributes (size, economic level, high/low tech) teacher qualities (attitudes on computer technology use, teacher knowledge of technology, and colleague use of technology) and teacher use of computer technology, job satisfaction, and compatibility of computer technology use and traditional teaching methods. Each hypothesis is presented below.

H1. There is no difference based on teacher attributes (age, years of service and education post-baccalaureate degree, and grade level taught) and teacher level of use of computer technology in lesson planning and delivery.

H2. There is no difference between school/district attributes (school/district size, economic level, and high/low tech) and teacher level of use of technology for lesson planning and delivery.

H3. There is no relationship between leadership (consisting of leader support, clear policies, and maintenance support of technology) and teacher level of use of computer technology for lesson preparation and delivery.

H4. There is no relationship between teachers' qualities (consisting of positive/negative attitudes on technology use and colleague use and knowledge of computer technology) and their level of use of computer technology for lesson planning and delivery.

H5. There is no relationship between teachers' qualities (consisting of positive/negative attitudes on computer technology use and colleague use and knowledge of technology) and perceived level of compatibility with traditional teaching methods.

H6. There is no relationship between leadership (consisting of leader support, clear policies, and maintenance support of technology) and the level of teacher-perceived job satisfaction related to computer technology.

H7. There is no relationship between teacher qualities (consisting of teacher attitudes, teachers helping each other with computer technology, and teacher knowledge) and the level of teacher-perceived job satisfaction related to computer technology.

H8. There is no relationship between leadership (consisting of leader support, clear policies, and maintenance support of technology) and effective use of computer technology in positively affecting students.

H9. There is no relationship between teacher qualities (consisting of teacher attitudes, teachers helping each other with computer technology, and teacher knowledge) and effective use of computer technology in positively affecting students.

Description of Survey Sample

The population for this study included elementary, middle, and high school teachers who work in New York State. An electronic survey was sent to two groups of teachers. One group was identified as teaching in high-tech schools, and the other group was identified as teaching in low-tech schools.

The high-tech and low-tech group determination was based on economic data that represented student eligibility for free and reduced-price lunch as reported by the New York State Education (2009-2010). The two high-tech districts were chosen on the basis of low

student eligibility for free or reduced-price lunch (18% and 2%). Two low-economic districts were chosen on the basis of high student eligibility for free lunch (65% and 51%) during the 2009–10 school year.

The survey was sent to 1,500 teachers. Of the 1,500 teachers sampled for the study, 120 (8%) responded. Although the return rate provided statistical significance, it was low. Individual *N* values vary in each survey item because some teachers did not respond to one or more survey items in accordance with the terms of the survey consent agreement. The *N* values for each survey item ranged from 110 to 120 and are detailed in the following sections. Specific descriptive information on the demographical profile of the participants is detailed below.

Teacher Profile

This section provides a demographic profile of the teachers who participated in this study. Details on the gender, age, race, years teaching, highest degree, and subject and grade level taught are described in this section. Table 1 presents teacher gender, age, and race. The sample was primarily female. This is reflective of the demographics of the teaching profession, which has a high percentage of females.

Table 1

Demographic Profile of Teachers in Sample (N = 120)

Demographics		*n*	%
Gender			
	Male	35	29.4
	Female	84	70.6
	Total	119	100.0
Age			
	20–25	7	5.9
	26–30	19	16.0
	31–35	26	21.8
	36–40	14	11.8
	41–45	17	14.3
	46–50	6	5.0
	51–55	11	9.2
	56–60	12	10.1
	61–65	5	4.2
	65+	2	1.7
	Total	119	100.0
Race			
	African American	2	1.7
	Asian	2	1.7
	Native American	0	0.0
	White	108	90.0
	Hispanic/White	6	5.0
	Hispanic/Black	1	0.8
	Other	1	0.8
	Total	120	100.0

Most of the teachers fall into the younger age categories, possibly because the retirement age for New York teachers is 55 years of age, with 30 or more years of service. Some teachers also move from the classroom to administrative positions in their later years. This move to administration also could explain the higher percentage of younger teachers in the sample. Another explanation for a greater response from younger teachers could be teacher turnover.

Table 1 also shows the race/ethnic breakdown of the respondents. The predominant group who responded to the survey was White. The next highest group was Hispanic/White. Both African American and Asian ethnicities were equal in having 2 respondents. Hispanic/Black was reported by one teacher. One teacher responded "Other," and none was Native American.

Table 2 presents teaching experience, highest degree attained, subject taught, and grade level taught. The teaching experience of the teachers ranged from those teaching 0–5 years to those teaching 36–40 years. The majority of teacher respondents fell into the first three categories. These three categories accounted for 68.3% of the sample.

Table 2

Characteristics of Teachers Surveyed

Teaching Characteristics		*n*	%
Years teaching			
	0–5	19	15.8
	6–10	35	29.2
	11–15	28	23.3
	16–20	17	14.2
	21–25	7	5.8
	26–30	7	5.8
	31–35	5	4.2
	36–40	2	1.7
	Total	120	100.0
Highest degree			
	Masters	23	20.0
	Masters Plus	87	75.7
	Doctorate	5	4.3
	Total	115	100.0
Subject taught			
	Elementary	43	36.1
	Math	9	7.6
	English	13	10.9
	Social Studies	7	5.9
	Foreign Lang	3	2.5
	Art	2	1.7
	Music	5	4.2
	Science	8	6.7
	Other	29	24.4
	Total	119	100.0
Grade taught			
	K–5	51	42.9
	6–8	29	24.4
	9–12	39	32.8
	Total	119	100.0

Respondents with 6–10 years of teaching experience had the highest representation in this sample. Respondents with 11–15 years of teaching experience had the next highest

representation in this sample. Respondents with 0–5 years of teaching experience were the third largest group.

Teachers who reported years of teaching experience in the 16–20, 21–25, 26–30, 31–35, and 36–40 categories comprised 31.7% of the sample. The 16–20 teaching experience category represented the largest number of these teachers (17; 14.2%). Both the 21–25 and the 26–30 category represented (5.8%) of the sample. Only 5 teachers (5.2%) were in the 32–35 category, and 2 teachers (1.7%) were in the 36–40 category.

The lower percentage of this sample that represented teachers with 16 years or greater teaching experience may be explained by teachers' moving into administrative roles, retirement, and career changes. Additionally, teachers with greater years of experience may be less likely to participate in a research study.

Table 2 also presents the level of education attained by teachers in this sample. The majority of teachers had a master's degree plus additional education (87; 75.7%) or a master's degree alone (23; 20.0%). Only five teachers reported an earned doctorate. This finding is consistent with the New York State requirement of attaining a master's degree to be eligible for professional certification.

In addition, Table 2 shows the subject taught by the participants in this study. The subject areas represented in this sample were diverse. The greatest number of respondents taught elementary subjects (43; 36.1%). Thirteen of the teachers taught English (10.9%), followed by 9 (7.6%) mathematics teachers, 8 (6.7%) science teachers, 7 (5.9%) social studies teachers, 5 (4.2%) music teachers, 3 (2.5%) foreign language teachers, and 2 (1.7%) art teachers.

An interesting finding was that 29 (24.4%) of the teachers reported their subject area as *other*. This finding is difficult to interpret, as the survey was sent to teachers in elementary, middle, and high schools. Subject areas generally taught in these schools were well represented as options in the demographic area of the survey. Additionally, technical schools were not included in this sample.

Table 2 also presents grade level taught by the teachers. This sample reflected teachers of the K–12 grade level (51; 42.9%), 6–8 grade level (29; 24.4%) and K–12 grade level (39; 32.8%). All grade levels are well represented in this sample.

The teacher characteristics of years teaching, highest degree attained, and subject and grade level taught were all well represented in this sample. In general, the sample showed a greater number of teachers with 16–20 years of experience or less, a master's degree or a master's degree plus additional education, a variety of subjects taught, and a variety of grade levels taught. The only unexpected demographic finding was the number of teachers (29) who reported *other* as subject taught.

School Characteristics

Demographic data related to school characteristics were also collected in this study and are shown in Table 3. School characteristics included student economic level, technology level, Internet connectivity, classroom computers, and student population. These data were obtained via a self-report survey of teachers.

Table 3

School Characteristics

Characteristics		*n*	%
Student Economic Level			
	High	8	6.7
	Middle	63	52.5
	Low	49	40.8
	Total	120	100.0
Technology Level			
	High	96	80.0
	Low	24	20.0
	Total	120	100.0
Internet Connectivity			
	Yes	117	98.3
	No	2	1.7
	Total	119	100.0
Classroom Computers			
	0	16	13.3
	1–5	77	64.2
	6–10	8	6.7
	10+	19	15.8
	Total	120	100.0
School Population			
	0–200	9	7.5
	201–400	21	17.5
	401–600	22	18.3
	601–800	13	10.8
	801–1000	33	27.5
	1000+	22	18.3
	Total	120	100.0

Student economic level was reported as middle by 63 (52.5%) of the teachers. Only 8 teachers (6.7%) reported the economic level of their students as high. These students were most likely in the schools reported as middle by other teachers. A low economic level of students was

reported by 49 (40.8%) of the teachers. This low economic student group is well represented in this sample.

Table 3 also reflects the teacher-reported technology level of the school. The majority of teachers (96; 80%) reported their school as having a high technology level. Only 24 (20.0%) reported that their school had a low technology level. This finding may be related to the economic factors that support technology in all schools in New York State.

Table 3 also denotes the Internet connectivity of the schools in this sample. An overwhelming number of teachers (117; 98.3%) report having Internet connectivity in their classrooms. Only 2 teachers (1.7%) reported lack of this technology. Again, lack of technology may relate to the dollars available specifically to support technology in schools in New York State.

The number of classroom computers is also presented in Table 3. Only 16 (13.3%) of teachers reported that their classrooms did not have computers. This finding is interesting, however, because 98% of teachers reported Internet connectivity in their classrooms.

The greatest number of computers in classrooms reported by teachers was in the 1–5 range (77; 64.2%). It is also interesting to note that 19 (15.8%) of the teachers reported 10 or greater as the number of the computers available in the classroom. Only 8 teachers reported 6-10 (6.7%) computers in the classroom. Clearly, the number of computers reported by teachers in the classroom reflects economic support for technology in the schools represented in this sample.

School population also was reported in Table 3. School population, as reported by teachers in this sample, was very diverse. Small schools with less than 200 students were not well represented (9; 7.5%). Large schools with greater than 801 students (33; 27.5%) and 1000 students were well represented (22; 18.3%).

School populations of 201–400 comprised 17.5% of the sample. Schools with 401–600 students represented a similar percentage (18.3%) of the sample. Schools with 601–800 students comprised only 10.8% of the sample.

It is important to note that school population was self-reported by teachers in this survey. This data was not supported by actual school district data reported to New York State regarding school population.

In conclusion, the school characteristics represented a mix of high/middle and low student economic levels, as reported by teachers. Technology level was very high, and Internet connectivity was almost universal. Few classrooms lacked computers; however, there was a disparity between the number of computers in the classroom and Internet connectivity. School populations were varied, but very few small schools with fewer than 200 students were included in this sample.

Comparative Analysis

Each of the demographic groupings of the sample was analyzed to determine whether there were any significant differences among groups, based on each of the intervening and dependent variables. To measure the difference between the means of two demographic groups, the researcher used a statistical test called a *t* test (Muijs, 2004). The results of the comparative analysis are detailed in the following paragraphs.

Gender

Gender was the first demographic grouping of teachers analyzed for comparative differences. Of the 120 teachers who answered the item on gender, 84 were female and 35 were male. Female and male responses to the dependent and independent variables were analyzed using *t* tests.

When comparing the responses of females and males on the dependent variables (level of job satisfaction related to technology, effective use of computer technology in lesson planning, effective use of computer technology in positively affecting students, and compatibility with traditional teaching), the researcher found no differences between women and men.

The comparison of responses of women and men to the intervening variables of leader support, clear leadership policy on the use of computer technology, computer maintenance support, teacher attitudes on computer technology use, and colleague use and teacher knowledge of computer technology also were analyzed. These results demonstrated some differences in mean scores between men and women.

The mean scores of men were higher than those of women in satisfaction with computer support (Table 4). The men had a higher mean score for both computer maintenance support and teacher knowledge of computer technology. However, this finding was not a statistically significant ($p < .05$) difference between men and women.

Table 4

Results of t test: Computer Maintenance Support by Gender

	Male $n = 35$		Female $n = 84$				
Variable	*M*	*SD*	*M*	*SD*	*df*	*t*	Sig.
Computer Maintenance support	4.10	.64	3.85	1.01	.25	1.36	.17

Note. Likert Scale: 1 = low, 5 = high.

Years Teaching

The second demographic grouping of the sample analyzed was the differences based on years teaching. The teachers were grouped into those with 16 years or more of teaching and 15 years or less of teaching. There were no statistically significant differences between teachers with 16 years or more experience and those with 15 years or less experience on any of the intervening or dependent variables.

Grade Level Taught

The third demographic grouping of the sample analyzed for comparative differences was grade level taught. Of the 90 teachers who answered the item on grade level as teaching in K–5 or 9–12, 51 taught in grades K–5 and 38 taught in grades 9–12. The responses of teachers in grades K–5 and teachers in grades 9–12 to the intervening and dependent variables were analyzed by using *t* tests.

When comparing the responses of teachers in K–5 and teachers in 9–12 on the intervening variables, the mean scores of teachers in 9–12 were higher than those in K–5. These mean scores represented teacher positive attitudes on technology use and teacher knowledge of computer technology. However, only one of these variables showed a statistically significant ($p < .05$) difference between teachers in grades 9–12 and teachers in grades K–5, indicating that teachers in grade 9–12 had a greater knowledge of technology than did those teachers in grades K–5 (Table 5).

Table 5

Results of t test: Attitudes and Knowledge Concerning Computer Technology by Grade Taught

	Grades K–5 $n = 51$		Grades 9–12 $n = 39$				
Variable	*M*	*SD*	*M*	*SD*	*df*	*t*	Sig.
Teacher attitude	4.35	.79	4.55	.59	.20	1.32	.18
Teacher knowledge	3.82	.91	4.48	.61	.66	3.92	.000

Note. Likert Scale: 1 = *low*, 5 = *high*.

When comparing the responses of teachers in grades K–5 and teachers in grades 9–12 to the dependent variables, the researcher found that the mean scores of teachers in grades 9–12 were higher than those in grades K–5 in level of job satisfaction related to computer technology and effective use of computer technology in lesson planning. However, only one of these variables showed a statistically significant ($p < .05$) difference between grade K–5 and grade 9–12 teachers. Teachers in grades 9–12 reported significantly more effective use of computer technology than did those in grades K–5 (Table 6).

Table 6

Results of t test: Satisfaction with and Effective Use of Computer Technology by Grade Taught

	Grades K–5 $n = 51$		Grades 9–12 $n = 39$				
Variable	*M*	*SD*	*M*	*SD*	*df*	*t*	Sig.
Satisfaction	3.35	1.07	3.71	1.12	.35	1.53	.12
Effective use	3.91	.83	4.27	.74	.36	2.13	.03

Note. Likert Scale: 1 = *low*, 5 = *high*.

When comparing the responses of teachers in grades K–5 and teachers in grades 6–8 to the intervening variables, the researcher found that the mean scores of teachers in grades 6–8 were higher than those of teachers in grades K–5 on the variable on computer support in the school. This variable did not demonstrate a statistically significant ($p > .05$) difference between grades K–5 and grades 6–8 teachers (Table 7).

Table 7

Results of t test: Satisfaction with Computer Support by Grade Taught

	Grades K–5 $n = 51$		Grades 6–8 $n = 29$				
Variable	*M*	*SD*	*M*	*SD*	*df*	*t*	Sig.
Satisfaction	3.73	.93	3.98	.84	.25	1.22	.22

Note. Likert Scale: 1 = low, 5 = high.

Another demographic grouping of teachers that was analyzed for comparative differences on grade level taught was teachers in grade level 6–8 and teachers in grade level 9–12. These group responses were analyzed based on the intervening and dependent variables, using *t* tests.

When comparing the responses of teachers in grade level 6–8 and teachers in grade level 9–12 to the intervening variables, the mean scores of teachers in grade level 9–12 were higher than the in grade level 6–8 for teacher knowledge of computer technology and teacher knowledge of computer technology in interactive lesson planning. These differences were statistically significant ($p < .05$). The mean scores of teachers in grade levels 9–12 were higher than those in grade levels 6–8 on use of computer technology in lesson planning; however, this difference was not statistically significant (Table 8).

Table 8

Results of t test: Knowledge and Use of Computer Technology by Grade Taught

Variable	Grades 6–8 $n = 27$		Grades 9–12 $n = 39$		*df*	*t*	Sig.
	M	*SD*	*M*	*SD*			
CT knowledge	4.33	.48	4.69	.46	.35	3.03	.003
CT in lesson planning	3.97	.77	4.33	.73	.36	1.98	.051
CT interactive lesson planning	3.52	.98	4.13	.84	.61	2.74	.008

Note. Likert Scale: 1 = low, 5 = high.

The comparison of responses of teachers in grade levels K–5 and teachers in grade levels 6–8 on all remaining dependent variables demonstrated no significant mean differences. There were no statistically significant differences between these groups in relation to the dependent variables.

School Attributes: Level of Technology of Schools

The comparison of responses of teachers who self-reported that they were in a school with high technology and teachers who reported a low technology of school to the intervening variables demonstrated a higher mean score for those in high technology schools on the effective use of computer technology in positively affecting students. This mean difference was statistically significant ($p = .05$).

The comparisons of teachers who reported teaching in high technology schools and teachers who reported teaching in low technology schools to the dependent variables of effective use of computer technology in lesson planning and compatibility with traditional teaching methods also demonstrated a mean difference. These variables, however, failed to demonstrate a

statistically significant ($p > .05$) difference between teachers in high technology schools and those in low technology schools (Table 9).

Table 9

Results of t test: Influence and Use of Computer Technology by Level of Technology in the School

	High $n = 94$		Low $n = 24$				
Variable	*M*	*SD*	*M*	*SD*	*df*	*t*	Sig.
Positive influence of CT	4.28	.724	3.79	.932	.485	2.754	.007
Use of CT in lesson planning	3.93	.930	3.54	.833	.384	1.841	.068
Compatible with traditional teaching methods	3.98	.884	3.71	.859	.270	1.342	.182

Note. Likert Scale: 1 = low, 5 = high.

Teachers who self-reported teaching in high-technology schools had a more positive attitude toward the effective use of computer technology in positively affecting students than did those in low-technology schools. This finding is not surprising, as high-technology school environments may influence teacher attitudes in this area.

Correlation Analysis Tests of Hypotheses

The purpose of this study was to examine how educational leader support (principal, assistant principal, and instructional leader), teacher demographics, school demographics, and teacher knowledge of and attitudes toward computer technology affected teacher job satisfaction, computer technology use in lesson preparation, effective use of computer technology in positively affecting students, and compatibility with traditional teaching methods. Null

Hypotheses 1 and 2 are related to teacher and school demographics and were compared to teacher knowledge and attitudes toward technology. They were compared using *t* tests.

The remaining hypotheses were tested using a statistical procedure called the Pearson product-moment correlation coefficient. This procedure calculated the direction and magnitude of the relationship between leadership and teacher qualities with the level of job satisfaction related to computer technology, effective use of computer technology in lesson planning, effective use of computer technology in positively affecting students, and compatibility with traditional teaching methods. The results of the analysis of each of the hypotheses are detailed in this section. The correlation matrix for each of these relationships is shown in Table 10.

Table 10

Correlations between Dependent and Intervening Variables

	Dependent Variables			
Intervening Variables	Job Satisfaction	CT with Lesson Planning	Effect on Students	Traditional Teaching
Leader support	.508**	.298**	.373**	.243**
Clear policy	.504**	.191*	.230*	.244**
CT maintenance	.503**	.388**	.419**	.173
Teacher attitudes	.317**	.616**	.583**	.469**
Teachers helping each other	.516**	.296**	.275**	.347**
Teacher knowledge	.501**	.740**	.713**	.456**

Note. *Correlation is significant at the $p < .05$ level.
**Correlation is significant at the $p < .001$ level.

Null Hypothesis 3: There is no relationship between leadership (consisting of leader support, clear policies, and maintenance support of technology) and teacher level of use of computer technology for lesson planning and delivery. As seen in Table 10, the variable lesson planning had a positive and highly significant ($p < .001$) correlation with the dependent variable use of computer technology for lesson planning ($r = .298$). The correlation between clear leadership policy on the use of computer technology and teacher use of computer technology had a positive, significant ($p < .05$) correlation with the dependent variable of computer support in lesson planning ($r = .191$). The correlation between computer maintenance support had a positive, highly significant ($p < .001$), moderate correlation with use of computer technology in lesson planning ($r = .388$). This null hypothesis was disproved for the leadership support variables.

Null Hypothesis 4: There is no relationship between teachers' qualities (consisting of positive/negative attitudes on technology use, teachers helping each other and knowledge of computer technology) and their level of use of computer technology for lesson planning and delivery. The correlation between teacher attitudes on technology use had a positive and highly significant ($p < .001$), moderate correlation with the dependent variable use of computer technology in lesson planning ($r = .616$). The correlation between teachers helping each other with computer technology had a positive, highly significant ($p < .001$) correlation with the dependent variable use of computer technology in lesson planning ($r = .296$). The correlation between the variable of teacher knowledge of computer technology had a positive, highly significant ($p < .001$), moderate correlation with the dependent variable use of computer

technology in lesson planning (r = .740). This null hypothesis was disproved for the variables of teacher qualities.

Null Hypothesis 5: There is no relationship between teachers' qualities (consisting of positive/negative attitudes on computer technology use, teachers helping each other with technology, and knowledge of technology) and perceived level of compatibility with traditional teaching methods. The variable teacher attitudes had a positive, highly significant (p < .001), moderate correlation with perceived level of compatibility with traditional teaching methods (r = .469). The variable of teachers helping teachers with computer technology also had a positive, highly significant (p < .001), moderate correlation with perceived level of compatibility with traditional teaching methods (r = .456). This null hypothesis was disproved for the variables of teacher qualities.

Null Hypothesis 6: There is no relationship between leadership (consisting of leader support, clear policies, and maintenance support of technology) and the level of teacher-perceived job satisfaction related to computer technology. The intervening variable leader support had a positive, highly significant (p < .001), moderate correlation with teacher job satisfaction related to computer technology (r = .508). Clear leadership policy on the use of computer technology also had a positive, highly significant (p < .001), moderate correlation with teacher job satisfaction (r = .504). Computer maintenance support also had a positive, highly significant (p < .001), moderate correlation with teacher job satisfaction (r = .503).

Null Hypothesis 7: There is no relationship between teacher qualities (consisting of teacher attitudes, teachers helping each other with computer technology, and teacher knowledge) and the level of teacher-perceived job satisfaction related to computer technology. The intervening variable of teacher attitudes had a positive, highly significant (p < .001), moderate

correlation with teacher job satisfaction related to computer technology ($r = .317$). Teachers helping each other with computer technology also had a positive, highly significant ($p < .001$), moderate correlation with teacher job satisfaction ($r = .516$). Teacher knowledge of computer technology additionally had a positive, highly significant ($p < .001$), moderate correlation with teacher job satisfaction ($r = .501$). Consequently, this null hypothesis was disproved for teacher qualities and teacher job satisfaction related to technology.

Null Hypothesis 8: There is no relationship between leadership (consisting of leader support, clear policies, and maintenance support of technology) and effective use of computer technology in positively affecting students. The intervening variable leader support had a positive, highly significant ($p < .001$) correlation with the dependent variable effective use of computer technology in positively affecting students ($r = .373$). There is a positive, significant ($p < .05$) correlation between clear leadership policy on computer technology and computer technology positively affecting students ($r = .230$). Finally, computer maintenance support had a positive, highly significant ($p < .001$), moderate correlation with this dependent variable ($r = .419$). Therefore, this null hypothesis was disproved for the variables leader support and effective use of computer technology in positively affecting students.

Null Hypothesis 9: There is no relationship between teacher qualities (consisting of teacher attitudes, teachers helping each other with computer technology, and teacher knowledge) and effective use of computer technology in positively affecting students. The intervening variable of teacher attitudes had positive, highly significant ($p < .001$), moderate correlation with this dependent variable ($r = .583$). Teachers helping teachers with computer technology also had a positive, highly significant ($p < .001$) correlation with effective use of CT in positively affecting students. Additionally, teacher knowledge of computer technology had a positive,

highly significant ($p < .001$), moderate correlation with this use of CT in positively affecting students. This null hypothesis was, therefore, disproved.

Correlation Analysis

A forward regression was conducted to relate the intervening and dependent variables. This analysis showed that leader support, clear leadership policies, teacher knowledge, teacher attitudes, and colleague use correlated positively with the dependent variables of teacher job satisfaction, effective use of computer technology for lesson planning and delivery, positive student affect, and compatibility with traditional teaching (Table 11).

Table 11

Correlation Analysis: Intervening and Dependent Variables

	Dependent Variables							
	Satisfaction		Effective use		Positive student use		Compatibility with traditional teaching	
Intervening Variables	Cor.	Sig.	Cor.	Sig.	Cor.	Sig.	Cor.	Sig.
Leader support	.508	.000	.298	.001	.373	.000	.243	.007
Leader policy	.504	.000	.191	.037	.230	.012	.244	.007
Computer maintenance support	.503	.000	.388	.000	.419	.000	.173	.058
Teacher attitudes	.317	.000	.616	.000	.583	.000	.469	.000
Colleague use	.516	.000	.296	.001	.275	.003	.347	.000
Teacher knowledge	.501	.000	.740	.000	.713	.000	.456	.000

The first regression determined which variables best predict teacher the use of computer technology for lesson planning and delivery. As seen in Table 12, two variables were good predictors of use of computer technology for lesson planning and delivery. Knowledge of computer technology of teachers was the strongest predictor of use of technology for lesson

planning and delivery. The second significant predictor of use of computer technology for lesson planning and delivery was the attitude of the teachers related to technology. Together, highly rated knowledge of computers and teacher attitudes related to computers when using the adjusted R-square explained 62% of the variance in teacher use of computers in lesson planning and delivery at the $p = .000$ level.

Table 12

Regression Analysis: Teacher Qualities that Predict the Use of Computer Technology for Lesson Planning and Delivery

Variable	*B*	*SE B*	*Beta*	*t value*	*p*
Knowledge of computers	.553	.065	.568	8.540	.000
Attitude re: computers	.353	.075	.316	4.722	.000
Colleagues' use of computers	.040	.058	.042	.697	.487

Note. $R = .792$, $R^2 = .627$, $AdjR^2 = .618$, $SE = .48976$, $df = 119$, F ratio = 65.096, $p = .000$.

The next regression model determined which variables best predict the dependent variable of compatibility with traditional teaching methods. As seen in Table 13, attitudes of teachers related to computer technology was the strongest predictor of compatibility with traditional teaching methods. Teacher knowledge of computers was the second significant predictor of compatibility with traditional teaching methods, and colleague use of computers was the third significant predictor of compatibility. Together, teacher attitude toward computers, knowledge of computers, colleague use of computers explained 31% of the variance in compatibility with traditional teaching methods and were significant at the $p = .000$ level.

Table 13

Regression Analysis: Teacher Qualities that Predict Compatibility with Traditional Teaching Methods

Variable	*B*	*SE B*	*Beta*	*t value*	*p*
Attitude re: computers	.266	.086	.279	3.073	.003
Knowledge of computers	.218	.075	.262	2.914	.004
Colleagues' use of computers	.155	.067	.189	2.321	.022

Note. $R = .562$, $R^2 = .316$, $AdjR^2 = .299$, $SE = .56645$, $df = 119$, F ratio = 17.892, $p = .000$.

The third regression analysis determined which variables were the best predictors of teacher job satisfaction related to computer technology. As seen in Table 14, leader support was the strongest predictor of teacher job satisfaction related to computer technology. The second significant predictor of teacher job satisfaction related to technology was computer maintenance support. The third significant predictor of teacher job satisfaction was a clear policy on computer technology use. Together, leader support, maintenance support, and clear policy use when using the adjusted R-square explained 39% of the variance, significant at the $p = .000$ level.

Table 14

Regression Analysis: School Leadership Qualities that Predict Teacher Job Satisfaction Related to Computer Technology

Variable	*B*	*SE B*	*Beta*	*t value*	*p*
Leader support	.299	.088	.288	3.396	.001
Maintenance support	.294	.104	.250	2.811	.006
Clear policy	.245	.094	.235	2.602	.010

Note. $R = .625$, $R^2 = .390$, $AdjR^2 = .374$, $SE = .85762$, $df = 119$, F ratio = 24.726, $p = .000$.

Conclusion

The findings from this research study provided information on teacher and school attributes, as well as how leadership and teacher qualities influenced the job satisfaction of teachers related to technology, the effective use of computer technology in lesson planning, the effective use of computer technology in positively affecting students, and the compatibility with traditional teaching methods. Grade level taught, level of school technology, leadership support, and teacher qualities generally increased job satisfaction related to technology and effective use of computer technology in lesson planning. Effective use of computer technology in positively affecting students and compatibility with traditional teaching methods also were influenced by a number of these factors.

Grade level taught affected teacher knowledge and use of computer technology. Teachers who taught in grades 9–12 reported the highest level of knowledge of computer technology and use in lesson planning when compared with teachers in grades K–5 and 6–8. However, there was little evidence of difference in level of job satisfaction and compatibility with traditional teaching methods related to grade level taught by these teachers. This finding may indicate a need to further evaluate computer technology in lower grade levels.

Teachers who self-reported their schools as high tech generally reported greater use of computer technology in lesson planning and compatibility of computer technology with traditional teaching methods. Effective use of computer technology in positively affecting students was much higher in the teachers who were in high-tech schools. This finding showed that school attributes related to technology level may also influence computer technology in education.

The importance of leadership in fostering computer technology in education was clearly supported in this study. Leader support, including a clear policy on computer use and computer maintenance support, affected teacher job satisfaction related to computer technology use. Leader support also increased teacher use of computer technology in lesson planning and the effective use of computer technology in positively affecting students. Leadership also influenced teacher view of computer technology as being compatible with traditional teaching methods.

Teacher qualities also influenced teacher job satisfaction with computer technology, effective use of computer technology, positive impact on students of computer technology, and compatibility with traditional teaching methods. The importance of the teacher qualities, including attitudes on computer technology use, helping each other in using computer technology, and knowledge of technology, also improved job satisfaction, effective use in lesson planning and positively affecting students, and compatibility with traditional teaching methods. Teacher qualities are a significant factor in computer technology use in education.

This study showed that teacher attributes, school attributes, leadership, and teacher qualities are all important in promoting computer technology in schools. Chapter V will provide a more detailed discussion of these findings, as well as implications, recommendations for future research, and recommendations for future practice.

CHAPTER V

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

Introduction

Early in their lives, K–12 students will have experienced a variety of multimedia computer technologies (Albirini, 2007; Vannatta & Fordham, 2004). Students are constantly exposed to auditory and visual stimulation. Additionally, beginning in 2001, preparing and delivering lessons with the use of computer technology have been required by public policies such as NCLB (2002) and Race to the Top (American Recovery and Reinvestment Act, 2009). This new requirement of using computer technology for lesson preparation and delivery requires a substantial financial investment on the part of taxpayers. Because teachers are the ultimate users of this technology for the preparation and delivery of lessons, their adoption of this new technology becomes essential.

The process of adopting an innovation can be explained by Rogers' diffusion of innovations theory (2003). This theory proposes that something new (an idea/item) is either accepted or rejected by a social group with similar attributes over a period of time. To study the adoption of computer technology by K–12 teachers, the researcher created the TRACT survey. This survey explored teacher/school demographics, leadership, and teacher qualities/attitudes related to computer technology adoption and use by teachers in K–12 schools.

The process of adoption also includes leader support of teachers using computer technology in the school, clear leadership policies on the use of computer technology, and computer maintenance support. Leader support may influence teacher use of computer technology, teacher job satisfaction related to computer technology, and effective use of computer technology in positively affecting students.

For computer technology to be adopted, teachers must demonstrate specific attributes. Teachers must have positive attitudes on computer technology use, have knowledge of computer technology, and be engaged in helping each other in using this technology. These attributes may also influence the level of teacher job satisfaction and the effective use of computer technology.

School attributes also may influence the adoption of computer technology in education. School size, economic level, and technology level all may impact the effective use of computer technology in lesson planning and the positive influence of computer technology in positively affecting students.

Is it reasonable to expect that education be positively influenced by the use of computer technology if the teachers are not committed to using it in effective ways? This study explored the process that teachers go through as they adopt or reject computer technology for the preparation and delivery of lessons.

Demographic Profile

After analyzing the data, the following demographic profile of teachers and school districts represented in the survey results was created. Female teachers comprised 70.6% (84) of the sample, with male teachers comprising 29.4% (35).

Age was the next demographic, with the highest concentration of teachers' falling into the 26–35 (37.8%) year range. Most of the teachers fell into the younger age categories. Possible explanations include retirement option at age 55, teacher turnover, and teachers' moving into administrative roles. Ethnically, White teachers represented the overwhelming majority of the respondents. Hispanics, both White and Black, were second, and African Americans and Asian came in third. This disparity would suggest that the non-White ethnic groups are underrepresented in the teacher populations of the K–12 schools surveyed.

Teaching experience ranged from 0 to 36 years, with the majority of teacher respondents having taught 6–10 years. The 0–15 year category represented 68.3% of the sample. Teachers who taught for longer than 15 years could have moved on to administration. Additionally, more experienced teachers could be more likely not to respond to a random survey. Having teachers with 6–10 years in the classroom could make the learning environment more productive, as these teachers are presumed to be better equipped to handle classroom issues such as discipline and lesson preparation and delivery.

A master's degree plus additional education was the predominant level of education attained by teachers in this sample (87; 75.7%). Only five teachers reported an earned doctorate. While this additional education is encouraging, it is important to note that, in New York State, teachers must achieve a master's degree within five years of provisional certification to achieve professional certification. Beginning in 2004, state law required teachers to be highly qualified in the subject taught to teach in K–12 schools. This certification requirement could explain the high number of master's degrees plus additional education of teachers in the sample.

The subject taught also was a demographic explored in the study. Although the subject categories were diverse, the greatest number of respondents taught elementary subjects (43; 36.1%). "Other," English, mathematics, science, social studies, music, foreign language, and art, respectively, made up the rest of the subjects taught. There were no clear indications that grade taught affected the use of computer technology use in the schools.

The final demographic of school characteristics included student economic level, technology level, Internet connectivity, classroom computers, and student population. The majority of teachers (63; 52.5%) in the study reported that the students in their schools came from a middle economic level. The next significant group was made up of low economic

students, as reported by 49 (40.8%) of the teachers. Only 8 teachers (6.7%) reported the economic level of their students as high.

Teachers also were asked to describe their perception of the technology level of their school. The majority of teachers (96; 80%) reported their school as having a high technology level. Only 24 (20.0%) reported that their school had a low technology level. This seems surprising, as many respondents (40.8%) said that the economic level of the students was low. It is interesting to note that teachers see their students as having a low economic status and yet believe that their schools have high computer technology. This categorization seems surprising because school districts rely on community tax rolls to provide computer hardware and computer support to both teachers and students. A possible explanation could be the infusion of resources by state or federal agencies.

Internet connectivity in the schools was rated highly (98.3%), and most classrooms had 1–5 computers (64.7%). Again, high Internet connectivity may relate to the state and federal dollars available specifically to support computer technology in schools. While 1–5 computers seem better than no computers, this number is hardly adequate for a typical class of between 22 and 30 students. It would seem that, besides teacher adoption of this new technology, more physical resources are needed before computer technology can become a viable tool for educating K–12 students.

Most teachers worked in schools with a diverse population; however, schools with fewer than 200 students were least represented (9; 7.5%). Large schools (greater than 801 students) and medium schools (201–400 and 401–600) were well represented. A school population of 201–400 comprised 17.5% of the sample. Schools with 60–800 students comprised only 10.8%

of the sample. It could be concluded that the surveyed teachers, because most worked in schools with a large population, had more varied experiences with computer technology use.

Intervening and Dependent Variables

This study explored the intervening variables as they affected the dependent variables. Leadership and teacher qualities were two categories examined in relation to the dependent variables. Leadership qualities included leader support of teachers using computer technology, clear leader policies on the use of computer technology, and computer maintenance support. Teacher qualities included teacher attitudes on computer technology, teacher knowledge of computer technology, and teachers helping each other use computer technology. This last variable speaks to one aspect of Rogers' (2003) diffusion of innovations theory, whereby an innovation is adopted through group members' influences on each other.

Respondents indicated a high satisfaction with leader support for teachers using computer technology. Leader support significantly affected the variables of job satisfaction, effective use, positive student impact, and compatibility with traditional teaching. Teachers were highly satisfied with leaders in their support of computer technology use for lesson planning and delivery. This study showed that leader support may result in higher teacher use of computer technology and may affect students positively and motivate teachers to include computer technology in their teaching methodology.

Teachers also reported that having a clear leadership policy on the use of computer technology is significant in their feeling satisfied on the job, effectively using computer technology in lesson planning, positively affecting students, and including computer technology use in their traditional teaching methods. Computer maintenance support was reported as being

significant in effective teacher use, positively affecting students, feeling satisfied with their job, and finding computer technology compatible with traditional teaching.

Three teacher qualities that may affect acceptance of an innovation were discussed in this study. A positive attitude on computer technology use, teachers helping each other, and teacher knowledge were statistically significant with effective use in lesson planning, compatibility with traditional teaching methods, affecting students positively, and job satisfaction. Teachers' knowledge of computer technology and their attitude related to technology were the strongest predictors of use of technology for lesson planning and delivery. Effective leaders, clear policies, computer maintenance support, positive teacher attitudes, teacher knowledge, and teachers helping each other had a positive effect on teachers' adopting computer technology for lesson preparation, job satisfaction, positive student impact, and inclusion of computer technology in lesson presentation.

Comparisons

Each of the independent variables was compared, using *t* tests to determine whether there were any statistical differences when compared to each of the intervening and dependent variables. Generally, there was little difference on some of the variables. Gender was analyzed and showed no significant differences, except that the mean scores of men were higher than those of women in satisfaction with computer support. Additionally, the men had a higher mean score for both computer maintenance support and teacher knowledge of computer technology. However, this finding was not a statistically significant ($p > .05$) difference between men and women. Statistically, males and females showed no appreciable differences in their responses. Gender has no impact on the intervening and dependent variables.

Responses on the second demographic, years in teaching, also were analyzed. The teachers were grouped into those with 16 years or more of teaching and 15 years or less of

teaching. There were no statistically significant differences between teachers with 16 years or more experience and those with 15 years or less experience on any of the intervening or dependent variables. This finding would indicate that years in teaching did not change the perceptions of teachers on leadership, teacher qualities, job satisfaction, effective use of computer technology, positive student impact, and compatibility with traditional teaching methods.

Grade level taught was the third demographic grouping that was analyzed for comparative differences. This grouping showed differences in the mean on teacher positive attitudes on technology use and teacher knowledge of computer technology. One of these variables showed a statistically significant ($p < .05$) difference between teachers in grades 9–12 and teachers in grades K–5. This indicates that teachers in grades 9–12 had a greater knowledge of computer technology than those teachers in grades K–5. This finding seems reasonable, as high school teachers need to be more expert in using computer technology for lesson planning. High school students are older and more sophisticated. They would need a higher level of planning to keep them involved and motivated. This need for a higher level of planning may have motivated teachers in grades 9–12 to learn more computer technology than did their elementary school colleagues.

Teachers in grades 9–12 reported significantly more effective use of computer technology than did those in grades K–5 and grades 6–8. Higher grades require more interaction and more intellectual involvement and could explain why high school teachers use computer technology more effectively than do grade K–5 teachers and grade 6–8 teachers. Teachers in grades 9–12 reported greater knowledge of computer technology in education and lesson planning than did those in grades K–5 and grades 6–8.

Teachers in high technology schools reported a more positive influence of computer technology on student education. The availability of computer technology that is effective and supported may influence teacher use. If there is a lack of computer resources, using computer technology for lesson preparation and positive student affect becomes extremely difficult, if not impossible. Most teachers reported having a high technology level in their districts. This could be encouraging to those who value using computer technology in enhancing educational outcomes. Teachers who taught in high technology schools had a more positive attitude toward the use of technology in interactive lesson planning than did teachers who taught in low-technology schools. Teachers who taught in high-technology schools also had a more positive attitude relating to the compatibility of computer technology to traditional methods of lesson planning.

Correlation Analysis

The researcher, through this study, sought to correlate the intervening variables of leader support, clear leadership policies, computer maintenance support, teacher attitudes, teacher knowledge, and teachers helping one another with the dependent variables. Leadership, consisting of leader support, leader policy, and computer maintenance support, had a positive correlation with the dependent variables of effective use, job satisfaction, positively affecting students, and compatibility with traditional teaching methods. All of the correlations were significant, with the exception of one.

Teachers' responses statistically demonstrated that they value positive leadership in feeling satisfied with their jobs. Leaders make a difference by supporting teachers in their use of computer technology. Because computer technology is a recent innovation, it must be endorsed by the administration for the teachers to feel motivated to use it for lesson planning. Computer technology use is not intuitive. It requires positive attitudes, knowledge, and commitment to

colleagues. These qualities would only be enhanced by a leader who believes in his or her teachers and supports their efforts in using computer technology for lesson planning and student support.

Regression Analysis

Forward regressions were conducted to determine which of the variables or combination of variables best predict the intervening variables of knowledge of computers, attitude related to computers, and colleague use of computer technology. The first regression determined which variables best predict teacher the use of computer technology for lesson planning and delivery. The two variables, knowledge of computer technology and positive attitudes related to technology, were good predictors of effective use for lesson planning and delivery. Knowledge of computers and positive teacher attitudes related to computers explained 62% of the variance in teacher use of computers in lesson planning and delivery.

The next regression model determined which variables best predict the dependent variable of compatibility with traditional teaching methods. Positive attitudes of teachers related to computer technology and teacher knowledge of computers were the strongest predictors of compatibility with traditional teaching methods. Teachers helping each other was the third significant predictor of compatibility. Teacher attitude toward computers, knowledge of computers, and teachers helping each other explained 31% of the variance in compatibility with traditional teaching methods and were statistically significant.

Leader support, clear policies on computer technology use, and computer maintenance support were the strongest predictors of teacher job satisfaction related to computer technology. Leader support, maintenance support, and clear policy ratings explained 39% of the variance and were highly significant.

Implications

This study provides important information that school leaders can use to influence teachers to adopt computer technology use. It also provides baseline data for future research on how leadership and teacher qualities influence teacher job satisfaction, effective computer use, positive student impact, and compatibility with traditional teaching methods. Leadership and teacher qualities have a significant impact on the adoption of computer technology for the enhancement of education. Leaders have a responsibility to support the teachers they supervise by encouraging the use of computer technology in lesson planning, providing clear policies on the use of computer technology in their schools, and providing computer maintenance support. If schools are to be compliant with the federal and state requirements to include computer technology in education, leaders must be members of the early adopters as described in Rogers' (2003) diffusion of innovations theory.

While research identifies the principal as the most important leader at the school level, teachers are the ones who implement computer technology use. The principal interacts with teachers on a daily basis and influences their daily performance. Teachers are more likely to adopt the use of computer technology if the school leader sets a positive example by encouraging teachers to prepare lessons that include computer technology use. Leader support will have many benefits. First, teachers will comply with current public policy requirements that computer technology be included in lesson plans. Second, teachers will feel satisfied with their jobs because they will be aligned with administration policies. Third, the effective use of computer technology will positively affect students by facilitating learning and raising educational standards. Fourth, teachers will feel more comfortable with using this innovation for lesson

presentation. Teachers who use traditional teaching methods can be positively affected and may incorporate computer technology in their methodology.

Teacher qualities influence the use of computer technology in lesson preparation. Teachers who have a positive attitude and are open to new ideas that may improve their students' ability to learn will feel more satisfied with their jobs. Their positive attitudes will inspire them to adopt many different methods to improve their profession. Their positive attitudes may motivate them to adopt computer technology use for lesson planning and delivery. Additionally, teachers who help one another will have a community vision and will reap the benefits of belonging to a social group. They may feel more satisfied with their jobs, positively affect students, effectively plan lessons, and find using computer technology compatible with their traditional teaching methods.

The more teachers know computer technology, the easier it will be to adopt that innovation for effective lesson planning. Knowledgeable teachers will feel more competent and more satisfied with their jobs. Computer technology knowledge also will positively affect students. Education will become student-centered and will increase student performance. Teachers who know technology are able to use their knowledge to prepare lesson plans interactively and incorporate computer technology use with their traditional lesson presentation.

Diffusion of Innovations Theory

This study used Rogers' (2003) diffusion of innovations theory to help understand how teachers adopt the use of computer technology in their preparation and delivery of lessons. This theory is the most appropriate for investigating the adoption of computer technology use in the K–12 educational setting. Following extensive and continuous research, Rogers found five attributes of innovations, relative advantage, compatibility, complexity, trialability, and

observability, that influence the decision process to adopt or reject an innovation. Gabriel Tarde, a French sociologist, classified innovation adopters as: early adopters, early majority, late majority, and later adopters.

Rogers (2003) identified several characteristics for each of the four segments. Innovators or early adopters have the ability to understand complex technical knowledge, serve as role models for others, are successful and respected by their peers, and hold the largest percentage of opinion leadership. Educational leaders and some teachers could be classified as early adopters, as they may possess the above-listed qualities. Presumably, leaders should be successful, respected by their peers, and hold the largest percentage of opinion leadership. Thus, they should be the innovators and empower teachers to use computer technology in the educational environment.

Teachers who are part of the early majority, one of the largest segments of the population, seldom hold positions of leadership opinion but are interactive with their peers. These are the teachers who do not jump at adopting computer technology but wait until they see a benefit in the adoption. Teachers in the late majority group are skeptical and cautious and will only adopt computer technology due to peer pressure. They will use the innovation because everyone is using it, and they feel left out if they do not. Teachers who are late adopters compose a small percentage of the population, hold on to traditional values, are usually isolated, and use the past as their point of reference. These teachers do not believe in anything new. Thus, they will resist adopting computer technology until they are forced by government policy enforced by educational leaders. Research supports the finding that faculty in schools of education exhibit the same characteristics presented in Rogers' diffusion of innovations theory (Sahin & Tompson, 2006).

Recommendations for Future Research

The data collected from this study provided adequate, baseline information about teachers' perspectives of training, leadership, and classroom computer technology. This study confirmed that teachers were generally satisfied with their jobs, used computer technology in lesson planning, used computer technology in positively affecting students, and felt that computer technology use is compatible with traditional teaching methodology. Teachers indicated that they valued leader support but that leaders needed to communicate computer technology policy more clearly. Future research that stems from various conclusions of this study is recommended.

This study confirmed that the educational leader is an essential factor in promoting the use of computer technology in the school environment. It would be beneficial for future research to examine the impact of the leader on teacher adoption of computer technology for lesson preparation and delivery. This research would provide the educational community with more information on how to motivate teachers to adopt worthwhile innovations that benefit students. Improving the interaction of educational leaders with teachers will promote a healthy environment and motivate teachers to implement innovations that enhance the educational community.

Recommendations for future research include:

1. *Conduct quantitative research on leadership from the teachers' perspective.* Because teachers implement policy and educational leaders enforce the implementation, it is important to consider the impact of leadership on teachers and the school system. Principals, assistant principals, and other educational leaders need to analyze and evaluate their own leadership skills to determine where they can begin to improve, thereby enhancing the job satisfaction and

efficacy of their teachers. Educational leaders should use a collaborative approach to motivate their teachers to perform their duties to the best of their abilities. This study looked at the process whereby teachers adopt the use of computer technology in lesson planning, job satisfaction, positive student impact, and us of computer technology with traditional teaching practices. Leaders should use Rogers' diffusion of innovations theory (2003) to understand how individuals and groups adopt an innovation. Because computer technology use was made a requirement by public policy, understanding the process of adoption will help ensure that teachers comply.

2. Conduct research on clear policies on the use of computer technology and the best practices in dissemination of these policies. School districts are responsible for enforcing federal, state, and local policies on the use of computer technology. Often, these policies are not communicated properly to the people who are tasked to implement them. This study found that teachers indicated that they need clearer policies communicated by educational leaders. This lack of information makes teachers feel unimportant and are counterproductive to a progressive culture.

Teachers represent a segment of the education community that should be included in the formulation of policies. Who better than the classroom teacher to offer input on how best to implement computer technology use? The usual practice of trickle-down requirements and laws often are not effectively implemented. Any innovation should be viewed as something that takes time for absorption and adoption. Leaders would be well served in researching how to better draft policies and how to best communicate them to the people who will implement them. Research on how the leadership should draft and communicate computer technology policy use

will improve job satisfaction, job efficacy, positive student impact, and compatibility with traditional teaching methodology of teachers.

3. Coordinate a national study on teacher adoption of computer technology use for lesson planning. Typically, teaching is a solitary profession in that teachers are isolated in a classroom and have little contact with colleagues. The weekly/monthly faculty meetings are structured as information gatherings. A better model would include staff meetings chaired by peers and tied to national teacher groups. This initiative would promote collegiality and give teachers a sense of connectedness to other professionals who work in different parts of the country. This approach would alleviate the feeling of isolation and possibly promote job satisfaction and effective computer technology use. This research also would promote a national identity whereby teachers would be able to set up organizations that offer national certifications. Teachers would then have a collective voice that could help promote the use of computer technology in education and would be hard to silence by every politician who has an agenda.

4. Conduct qualitative research on job satisfaction related to using computer technology in lesson planning. When principals and teachers were asked whether they were satisfied with their jobs, the response was generally positive. A qualitative study that is designed to view the principal and teacher during a typical work day would be more revealing. The satisfaction of the educational leaders and teachers would be observable. The results would provide a platform for helping educational professionals choose practices that enhance job satisfaction in promoting computer technology. The more that principals and teachers feel satisfied with their jobs, the more they will feel accomplished and become more productive.

5. Conduct qualitative research on the experiences of teachers in high-tech and low-tech districts. This study showed that teachers perceived one-third of their students' coming from a

low socio-economic group. Yet, when asked whether their districts were high or low tech, teachers overwhelmingly perceived their districts as being high tech. Future research should focus on high and low socio-economic as well as urban and rural school districts. Qualitative research can provide a more detailed perspective of teachers on high and low tech. The findings from this research sought to help educational leaders and teachers understand the perceived qualities that differentiate the two types of districts. This information enhances the body of knowledge and helps promote computer technology use more widely.

Recommendations for Practice

The researcher studied leadership support, clear leadership policy on the use of computer technology, computer maintenance support, teacher qualities, teachers helping each other, and teacher knowledge of computer technology as they affected teacher job satisfaction, effective use of computer technology, positive student impact, and compatibility with traditional teaching methodology. Generally, teachers felt satisfied with their jobs, used computer technology, stated that computer technology affected students positively, and incorporated computer technology into their traditional teaching methodology. It is encouraging to see that the perceptions of the teacher participants were overwhelmingly positive on the adoption of computer technology. The following recommendations for practices based on these findings will further promote computer technology use on the K–12 level.

1. *Establish district-wide teacher committees for the implementation of computer technology for lesson planning.* Teachers are responsible for using computer technology in lesson planning and delivery, but they do not have the opportunity to plan on a district level. District-wide planning would ensure uniformity as well as providing teachers with time to consult and plan collaboratively. Teachers would utilize each other's creativity in their planning.

Additionally, challenges that arise from computer technology use could be discussed and solved at these meetings. Providing teachers with release time will be challenging for administrators. Despite this concern, the benefits from these meeting will far outweigh the challenges.

2. *Have teachers study Rogers' (2003) diffusion of innovations theory and create a study group to suggest best practices to promote computer technology use.* Teachers should learn the process of adopting an innovation. Learning the process will enable teachers see where they are in relation to adopting computer technology use in lesson preparation. Often, teachers are told that they have to include certain procedures in their pedagogy. Requirements without their input may make teachers feel uncomfortable and, thus, may hinder implementation. Incorporating the use of computer technology in lesson preparation is not intuitive. A knowledge base must be established before a teacher feels comfortable using this new technology. It becomes circular in that a teacher will invest time and effort only when they see the value and the importance for their profession. This study group can report back to the teachers at faculty meetings and positively influence their colleagues to adopt the use of computer technology in their lesson planning and delivery.

3. *Provide principals with computer technology training*. Modeling is the best way a principal can support his or her teaching staff in the use of computer technology use. If teachers view principals as early adopters of the innovation of computer technology, they are more likely to adopt it themselves. Learning to use computer programs requires education. This education must begin with the leaders so that teachers see the importance of using computer technology in their lesson planning. The teachers would naturally deduce that, if the principal knows computer technology, they should learn and then use it for lesson planning and delivery. Leaders build

confidence by modeling the behavior they expect from their teachers. Leaders' knowledge of computer technology will promote teacher use of computer technology in their lesson planning.

4. Provide teachers with technical support. Educational leaders must provide technical computer support to teachers in their charge. In a study by Butler and Sellbom (2002), an identified barrier to adopting computer technology in the classroom was the lack of technical computer support. This support was identified as including a high-level technology coordinator as well as technical support personnel.

Providing a computer technology coordinator or director in each school or district has been identified as a successful strategy to ensure administrative and pedagogical resources for the teachers. The coordinator or director can advise teachers on computer technology solutions. They also can provide assistance with teaching and learning problems, help teachers acquire technology resources, conduct training needs assessments of teachers related to computer technology, and advise them on professional development (Howland & Wedman, 2004).

The technology coordinator or director may also coordinate technology assistants who ensure computer technology functionality. The availability of technical assistants may help teachers use computers efficiently in the classroom. This availability of support personnel may alleviate teacher anxiety in the use of computer technology in the event of a malfunction.

5. Provide teachers with more computer technology education. Most faculty professional development related to computer integration in schools and school districts is held in short workshops with limited support and follow-up for integration (Hargreaves, 2005). For this technology to be integrated by teachers, teacher education must become a systematic learning effort as part of professional development. A learning plan must be initiated by educational leaders and implemented using a collaborative model that includes teachers. The

first goal is that teachers will use technology to plan and deliver lessons that are based on curriculum, relevant to the learners and based on principles of effective teaching and learning. The second goal is that teachers will use technology, where appropriate, and support learner expression. The third goal is that teachers will locate, evaluate, and select appropriate resources for the content area and target student grade levels. This model meets the recommendation that infusion of technology should not be taught in a stand-alone course (Handler, 1993).

6. *Provide teachers and students with reliable computer networks*. Research shows that deficiencies in the computer networks may be a limitation to computer integration in the classroom (Milken/ISTE, 2000). The lack of a viable computer network has been identified as a limitation to teacher use of computer technology. Richardson (2000) conducted a survey of one Australian school that provided teachers with notebook computers and their own web spaces. The results of this study showed that many teachers integrated this technology into their teaching and learning processes. Richardson concluded that hardware, software, and network infrastructure must be available to integrate computer technology in lesson preparation and delivery. Grove et al. (2004) conducted a qualitative study of 16 teachers in Washington, DC. They found that, to support student centered lesson with technology, a viable computer network and on-site support were essential. This on-site support required mentoring of teachers in the use of available computer technology.

Gulbahar (2005) stated that providing up-to-date hardware and software resources are key components to the diffusion of computer technology. Educational leaders must make sure that there is appropriate funding for both the technology and resources necessary to promote integration into the classroom. They can accomplish this through the budget process and applying for external funding.

7. Make the leadership role one of change agent and collaborator. Educational leaders are accountable and responsible for establishing a policy and a plan for the integration of technology in schools. This system should be based on a well-defined mission that describes computer technology's place in education. The absence of a systematic and planning strategy can hamper the integration of computers in the classroom (Cuban, 2001).

Anderson and Dexter (2000) have noted that a school leader's computer technology vision is essential to effective technology integration in the classroom. The leader should not envision a top-down process, but, rather, solicit contributions from all of the stakeholders in the school. These stakeholders should include educational leaders, computer technology experts, teachers, parents, students, and the community.

Educational leaders should collaborate with cross-disciplinary groups of teachers and technology coordinators to develop a technology integration plan. This plan should enumerate how teachers are expected to integrate computer technology in their lesson preparation and delivery. It should include well-constructed mission and vision statements, an integration plan, an up-to-date hardware infrastructure, teacher training, and education and leader support (Anderson & Dexter, 2000).

Leaders also must ensure that teachers have time to experiment and interact with computer technology. Mumtaz (2000) stated that lack of time is a factor that hampers the implementation of computer technology in schools and suggests that release time and scheduled time be made available to the teachers. A study conducted by the National Center for Educational Statistics (2000) further supports this assertion and concluded that 82% of the teacher participants reported that lack of release time was the most significant factor that prevented them from using computers in their classrooms as well as in preparation of lessons.

8. Create a school culture that supports computer technology use in lesson planning. The educational leader must help create a school culture that supports and values the use of computer technology by teachers. School culture is important to the integration of computer technology in schools (Tearle, 2003). School culture represents the basic assumptions, norms, values and cultural artifacts shared by school members (Maslowski, 2001).

Albirini (2006) further supports the importance of school culture to the integration of computer technology in the classroom. He suggested that a mismatch of values between the school culture and the use of computer technology influences teacher acceptance and use in the classroom. He further stated that teachers who have positive perceptions of cultural relevance regarding computer technology will use it in their lesson preparation and delivery (Albirini, 2006).

The leader can create a positive computer technology use school culture by providing clear policies on the value of computer technology use, providing ongoing education, having a director of technology on staff, modeling the use of computer technology, and providing a reliable computer system.

Conclusion

This research study provided information on teacher attributes and school attributes as well as how leadership and teacher qualities influenced the job satisfaction of teachers related to technology, the effective use of computer technology in lesson planning, the effective use of computer technology in positively affecting students, and the compatibility of computer technology use with traditional teaching methods.

The public education policy of the United States was changed dramatically by the enactment of the NCLB (2002) legislation. The major goal of this legislation was to improve

student achievement. The legislators who drafted the NCLB legislation (2002) recognized the value of computer technology as a tool to improve student achievement and, thus, required computer technology use in K–12 education. Studies show that the primary determinant of whether computer technology use succeeds or fails is the teacher (Albirini, 2007; Brush & Bitter, 2000; Cagle & Hornik, 2001). The skills and attitudes of the teacher determine the effectiveness of technology integration into the curriculum (Cuban, 2001; Ravitz et al., 2000). A report by the U.S. Department of Education (2004) showed that the comfort and skills of teachers may affect their use of technology.

If teachers are the ones who are required to use computer technology for lesson preparation, how do they adopt this innovation? One of the models frequently used to comprehend change is the Rogers' diffusion of innovations theory (Rogers, 1995, 2003). This theory was the most appropriate for investigating the adoption of technology in the K–12 educational environment (Medlin, 2001; Parisot, 1995). Five attributes of adoption which educational leaders must address according to Rogers (2003) include: relative advantage, compatibility, complexity, trialability, and observability. Rogers (2003) categorized the attributes of innovation and hypothesized that, if people met these attributes, they were significantly more likely to be persuaded to make a decision to implement and, eventually, adopt an innovation. Rogers (2003) related these attributes and their relationship to persuasion, which affects the decision to adopt or reject an innovation. Confirmation would then take place and determine the continued use of the innovation.

This study indicated that teachers felt satisfied in their jobs, used computer technology in lesson planning, felt that students were positively influenced by using computer technology, and felt that computer technology use was compatible with traditional lesson delivery. Teachers

perceived that their leaders supported them in computer technology use in general and computer maintenance support in particular. Teachers felt knowledgeable in computer technology, felt that they helped each other in the use of computer technology, and had a positive attitude toward the use of computer technology.

The findings in this study were based on the perceptions of teachers, an essential group in using computer technology for lesson planning and delivery. Future research can use these findings to enhance the body of knowledge on how educational leaders and teachers can best adopt the innovation of computer technology use to enhance student achievement.

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APPENDIX A

TEACHER REVIEW AND ASSESSMENT OF COMPUTER TECHNOLOGY TRACT SURVEY

TEACHER REVIEW AND ASSESSMENT OF COMPUTER TECHNOLOGY TRACT SURVEY.

Informed Consent

Protocol Title: THE DIFFUSION OF COMPUTER-BASED TECHNOLOGY IN K–12 SCHOOLS: TEACHERS' PERSPECTIVES OF TRAINING, LEADERSHIP AND CLASSROOM COMPUTER TECHNOLOGY.

Please read this consent document carefully before you decide to participate in this study. You will be given a copy of this consent form regardless of whether or not you decide to participate.

Purpose of the research study: The purpose of this study is to examine how teachers comply with the requirements of federal, local educational agencies and school leaders in using computer technology in their classrooms. This study will seek to contribute to and enhance the body of knowledge on teachers' use of computer technology in lesson preparation and delivery.

What you will be asked to do in the study: Participants will be asked to respond to a 36-question online survey.

Time required: The survey will take approximately 15 minutes to complete

Risks and Benefits: There are no foreseeable risks for participating in the study. Individual participants will not benefit from this study directly. However, participation will contribute to an expanding knowledge base on how teachers use the innovative method of computer technology for lesson preparation and delivery.

Anonymity: Your identity in this study would be anonymous. It will not be possible to know who chooses to participate in this study and who did not. It will also not be possible to know who completed which questionnaire. Responses will only be analyzed as part of the larger group data. Data will be maintained for approximately 60 days after the survey is closed and will only be accessible by the researcher and one faculty advisor from Fordham University. This research will use a web-based, electronic survey instrument. Electronic surveys can be programmed to collect data on the Internet Protocol (IP) addresses of respondents. The survey software will not be programmed to collect IP addresses from any of the participants, ensuring complete anonymity.

Voluntary participation: Participation in this study is completely voluntary. There is no consequence for not participating, and you may refuse to answer any of the questions. Participants must be 18 years of age or older.

Right to withdraw from the study: You may withdraw from this survey at anytime, even if you begin the survey.

Whom to contact if you have any questions about the study: John L. Colandrea, cell: (631) 793-1587; e-mail: colandr12@gmail.com

Whom to contact about your rights as a research participant in the study: E. Doyle McCarthy, Chair of the

Fordham University Institutional Review Board, 113 W. 60th Street, New York, NY 10023-7484, Phone: 212-636-7946, FAX: 212-636-6482, E-mail: IRB@fordham.edu

Agreement: I have read the procedure described above. By clicking on the "BEGIN SURVEY" arrow below you are indicating that you voluntarily agree to participate in the procedure and that you have received a copy of this description. Please print a copy of this consent form for your records.

BEGIN SURVEY

DEMOGRAPHICS: TEACHER ATTRIBUTES

1. Age

- 1=20-25
- 2=26-30
- 3=31-35
- 4=36-40
- 5=41-45
- 6=46-50
- 7=51-55
- 8=56-60
- 9=61-65
- 10=Over 65

2. Race

- 1=African/Caribbean American
- 2=Asian/Pacific Islander
- 3=Native American/Aleutian
- 4=White
- 5=Hispanic/White
- 6=Hispanic/Black
- 7=Other

3. Gender

- 1=Male
- 2=Female

4. Years of Teaching Experience

- 1=0-5
- 2=6-10
- 3=11=15
- 4=16-20
- 5=21-25
- 6=26-30
- 7=31-35
- 8=36-40
- 9=Over 40

5. Highest Educational Level Achieved

- 1=Masters Degree
- 2=Masters Degree Plus Additional Education
- 3=Doctoral Degree

6. Subject Taught

- 1=Elementary
- 2=Math
- 3=English
- 4=Social Studies
- 6=Art
- 7=Music
- 8=Science
- 9=Other

☐ 5=Foreign Language

7. Grade Level Taught

☐ 1=K -- 5 ☐ 3=K -- 12

☐ 2=6 -- 8

8. Economic Level of Students Attending My School

☐ 1=High ☐ 3=Low

☐ 2=Middle

9. Computer Technology Level of My School

☐ 1=High ☐ 2=Low

10. I have Internet Connection in My Classroom

☐ 1=Yes ☐ 2=No

11. Number of Computers in My Classroom

☐ 1=0 ☐ 3=6-10

☐ 2=1-5 ☐ 4=More than 10

DEMOGRAPHICS: DISTRICT/SCHOOL ATTRIBUTES

12. Number of Students Attending My School

☐ 1=0-200 ☐ 4=601-800

☐ 2=201-400 ☐ 5=801-1000

☐ 3=401-600 ☐ 6=Greater than 1000

LEADERSHIP

13. My administrators support me in the use of computer technology for lesson preparation and delivery.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

14. My administrators provide me with ongoing support in the use of computer technology in the classroom.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please Indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

15. There is a clear policy for the use of computer technology in my school.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

16. The computer technology policy is clearly communicated to teachers by my administration.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

17. Computer maintenance support is scheduled regularly.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

18. A computer maintenance professional supports me.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

19. A highly qualified Director of Technology supports the overall maintenance of the computer

network in my school.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

TEACHER QUALITIES/ATTITUDES

20. The use of computer technology is beneficial in my lesson planning and lesson preparation.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

21. The use of computer technology is beneficial in my lesson delivery.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

22. My use of computer technology enhances students' educational experiences.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

23. Most of the teachers in my school use computer technology in their lesson preparation.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

24. Most of the teachers in my school promote the use of computer technology in their classrooms.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

25. I have knowledge of computer technology.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

26. My knowledge of using computer technology for lesson delivery is extensive.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

27. I am highly satisfied with the available technology infrastructure in my school.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

28. I am highly satisfied with the computer technology available in my classroom.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

29. I am highly satisfied with the use of computer technology in my school.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

30. I use computer technology effectively in my lesson planning.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

31. I use computer technology effectively in planning lessons interactively.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

32. I use computer technology effectively in my classroom so that students are positively affected.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

33. I use computer technology effectively in my classroom for lesson delivery.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

34. Computer technology is compatible with my teaching methods.

	Strongly Disagree	Disagree	Uncertain	Strongly Agree	Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

35. My using computer technology in lesson planning is compatible with traditional methods of planning.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

36. My computer technology use is compatible with traditional lesson presentation.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Please indicate your level of agreement with the statement above.	☐	☐	☐	☐	☐

APPENDIX B

E-MAIL TO PROSPECTIVE PARTICIPANTS

E-mail to Prospective Participants

Dear Teacher:

My name is John Colandrea and I am a Doctoral Candidate at Fordham University. I would like to invite you to participate in my study: THE DIFFUSION OF COMPUTER-BASED TECHNOLOGY IN K–12 SCHOOLS: TEACHERS' PERSPECTIVES OF TRAINING, LEADERSHIP AND CLASSROOM COMPUTER TECHNOLOGY.

If you decide to participate, you will be asked to complete an online survey, which will require approximately 15 minutes to complete. Your participation is completely voluntary, and you may withdraw your participation at any time during the survey. This is an anonymous survey. Your answers cannot be linked to you in any way.

To participate in this study, please click on the link below and read the letter of informed consent. A link to begin the survey is also located at the bottom of the letter.

Link to survey https://www.surveymonkey.com/s/H5RZ9ZY.

Link to Informed Consent letter https://www.surveymonkey.com/s/9BV8C28.

Feel free to contact me at: (631) 793 1587; e-mail -- colandr12@gmail.com.

Thank you very much for your time and consideration.

Sincerely,

John L. Colandrea

APPENDIX C

LETTER OF INFORMED CONSENT

Letter of Informed Consent

GRADUATE SCHOOL OF EDUCATION

Informed Consent

Protocol Title: THE DIFFUSION OF COMPUTER-BASED TECHNOLOGY IN K -- 12 SCHOOLS: TEACHERS' PERSPECTIVES OF TRAINING, LEADERSHIP AND CLASSROOM COMPUTER TECHNOLOGY.

Please read this consent document carefully before you decide to participate in this study. You will be given a copy of this consent form regardless of whether or not you decide to participate.

Purpose of the research study: The purpose of this study is to examine how teachers comply with the requirements of federal, local educational agencies and school leaders in using computer technology in their classrooms. This study will seek to contribute to and enhance the body of knowledge on teachers' use of computer technology in lesson preparation and delivery.

What you will be asked to do in the study: Participants will be asked to respond to a 36-question online survey.

Time required: The survey will take approximately 15 minutes to complete

Risks and Benefits: There are no foreseeable risks for participating in the study. Individual participants will not benefit from this study directly. However, participation will contribute to an expanding knowledge base on how teachers use the innovative method of computer technology for lesson preparation and delivery.

Anonymity: *Your identity in this study would be anonymous. It will not be possible to know who chooses to participate in this study and who did not. It will also not be possible to know who completed which questionnaire.* Responses will only be analyzed as part of the larger group data. Data will be maintained for approximately 60 days after the survey is closed and will only be accessible by the researcher and one faculty advisor from Fordham University. This research will use a web-based, electronic survey instrument. Electronic surveys can be programmed to collect data on the Internet Protocol (IP) addresses of respondents. The survey software will not be programmed to collect IP addresses from any of the participants, ensuring complete anonymity.

Voluntary participation: Participation in this study is completely voluntary. There is no consequence for not participating, and you may refuse to answer any of the questions. Participants must be 18 years of age or older.

Right to withdraw from the study: You may withdraw from this survey at any time, even if you begin the survey.

Whom to contact if you have any questions about the study: John L. Colandrea, cell: (631) 793-1587; e-mail: colandr12@gmail.com

Whom to contact about your rights as a research participant in the study: E. Doyle McCarthy, Chair of the Fordham University Institutional Review Board, 113 W. 60th Street, New York, NY 10023-7484, Phone: 212-636-7946, FAX: 212-636-6482, E-mail: IRB@fordham.edu

Agreement: I have read the procedure described above. By clicking on the "BEGIN SURVEY" arrow below you are indicating that you voluntarily agree to participate in the procedure and that you have received a copy of this description. Please print a copy of this consent form for your records.

BEGIN SURVEY

APPENDIX D

FORDHAM UNIVERSITY INSTITUTIONAL REVIEW BOARD APPROVAL

Fordham University Institutional Review Board Approval

Institutional Review Board

Report of Action

REVIEW DATE:		*12/3/11*
PROJECT TITLE:		The diffusion of computer-based technology in K -- 12 schools: Teachers' perspectives of training, leadership and classroom computer technology
PRINCIPAL INVESTIGATOR:		John Louis Colandrea
SCHOOL/DEPARTMENT:		Education
REVIEW TYPE:	___x___new	_____continuing _____if continuing, date of last review
	_____exempt (category)	___7___expedited (category) _____full board
RISK JUDGMENT:	___x___minimal risk	_____greater than minimal risk
	_____risk with direct benefit (for minors)	_____risk with no direct benefit (for minors)
IRB ACTION: (date)	___x___approved	_____approval pending 12/2/12 approved until

Your response to the initial Report of Action has satisfactorily addressed the concerns of the Fordham IRB and you are now free to proceed with data collection pending receipt of your site approval letters AND once the Associate Dean of Academic Affairs has approved your dissertation proposal. Site approval letters should be on official letterhead and signed by an authorized representative.

The IRB approved the protocol for one year as described in your application, by expedited continuing review under category 7 of Federal Regulation 45 CFR 46.101.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Please note the following:

- Multiple year projects require continuing review. It is the responsibility of the researcher to submit an IRB protocol prior to the end of the approved period, December 2012.
- Copies of the enclosed letterhead must be used in obtaining informed consent. If there is a need to revise or alter the consent form(s), please submit the revised form(s) for IRB review and approval prior to use. If this protocol concerns an online study, you do not need to include the Fordham letterhead. However, you should make sure you upload the IRB stamp so that participants know that your study has been reviewed and approved by the Fordham IRB.
- Please remember to submit the most recent versions of your consent/assent forms as well as your revised protocol to the IRB office. You also must have a site agreement letter on file, if applicable, prior to data

collection. The investigator(s) identified above are required to retain an IRB protocol file, including a record of IRB-related activity, data summaries and consent forms. This file is to be made available for review for internal procedural (audit) monitoring.

Please also note that changes to procedures involving human subjects may not be made without prior IRB review and approval. The regulations also require you to promptly notify the IRB of any problems involving human subjects, including unanticipated side effects, adverse reactions, and any injuries or complications that arises during the project.

If you have any questions or concerns, please feel free to contact the IRB office or me. Best of luck with your research.

12/3/11

Akane Zusho, Ph.D — Date

For the Institutional Review Board

VITA

JOHN LOUIS COLANDREA

Date of Birth	July 26, 1945
Place of Birth	Naples, Italy
Bachelor of Arts	University of Dayton Dayton, Ohio 45469 Conferred: June, 1967
Master of Arts	State University of New York at Stony Brook Stony Brook, New York 11794 Conferred: December, 1973
Master of Science in Ed./ Professional Degree	College of New Rochelle New Rochelle, New York 10805 Conferred: August, 2003
Academic Positions	Teacher of English Farmingdale Public Schools Farmingdale, New York 11735 1968-1978
	Director of Information Systems Briarcliffe College Bethpage, New York 11714 2000-2001
	Teacher of Computer Repair and Networking Eastern Suffolk BOCES Oakdale, New York 11769 2001-2004
	Assistant Principal Western Suffolk BOCES Farmingdale, New York 11735 2004-2011