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FACTORS AFFECTING THE LEVEL OF TECHNOLOGY IMPLEMENTATION BY TEACHERS IN ELEMENTARY SCHOOLS

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FACTORS AFFECTING THE LEVEL OF TECHNOLOGY IMPLEMENTATION BY TEACHERS IN ELEMENTARY SCHOOLS

A DISSERTATION APPROVED FOR THE
DEPARTMENT OF EDUCATIONAL LEADERSHIP AND POLICY STUDIES

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ABSTRACT

Technology investing in public schools has reached historical levels, yet the impact on student achievement has been under-realized. Despite annual increases in school technology expenditures, there are still limited cases of schools and teachers using technology in ways that impact student achievement. Many studies have focused on first order barriers such as access to computers, access to software, and access to technology support. The number of studies focusing on second order barriers such as teacher efficacy and instructional practices is much less prevalent. These unique conditions must be realized and addressed if schools are going to embrace technology as a tool to improve student achievement.

This study is based on the survey completed by 146 teachers in 15 elementary schools. Descriptive statistics, regression analysis, and correlation were used to examine the relationships between the level of technology implementation and the following independent variables: current instructional practices, personal computer use, poverty concentration within a school, teacher efficacy, and demographic variables including gender, age, attainment of an advanced degree, years of classroom teaching experience, school culture, and principal support. The results of the study determined a significant relationship between the level of technology implementation and personal computer use, current instructional practices, and teacher efficacy. Additional findings indicated a statistically significant negative relationship between the following: age and both personal computer experience and current instructional practices; and years of experience and both personal computer use and current instructional practices. Also, a statistically

significant relationship was determined to exist between a teacher's sense of efficacy and both personal computer use and current instructional practices.

CHAPTER I

INTRODUCTION AND OVERVIEW

Introduction

In 1913, Thomas Edison said books would become obsolete in schools and all students would be instructed by the motion picture. He predicted the school system would be completely changed within ten years. In 1922, he proclaimed the uselessness of textbooks. He stated textbooks were about 2% efficient, but believed the motion picture would eventually be 100% efficient in the classroom (Chaptal, 2002). Similarly, an original advertisement for the overhead projector claimed that it would reduce discipline problems, allow teachers to sit and face their pupils, conserve teacher energy, eliminate the need for an assistant and cause students to concentrate (Cuban, 1993). In 1999, Roberts (1999) stated, “I suppose the biggest mistake we could make is to assume that technology in and of itself, whether it’s multimedia programs, the Internet, or any other application, is the silver bullet…Technology alone is not the driver of student performance or acquisition of skills (Chaptal, 2002). While the above statements now seem humorous in the 21st century, they all have one thing in common. They are symbolic of the constant search to find a magic pill to improve student achievement. They are all symbolic of the fact that technology, regardless of what type, is not a stand alone answer to improving student achievement.

Despite critics who argue against the influx of technology in American schools, the level of technology spending for public schools in the United States was projected to be more than 9.5 billion dollars in 2006 (Kane, 2003). According to a 2002 Benton Foundation report, the United States had, at that time, spent over 38 billion dollars to place technology and Internet access in America's schools. One reason for these continued expenses could be that parents and community members believe that computers in the classroom are synonymous with progress in education and preparing their children for the workplace (Peters, 2002). However, in the 21st century, just the mere presence of computers and boasting of a computer in every classroom can no longer be a measure of a school's efforts to improve student achievement (Garthwait, 2001). Maddux (1993) noted that there is nothing spectacular that occurs as a result of placing a computer in the classroom. Rather, the difference occurs as a result of how and for what the computer is used.

For supporters of technology's ability to improve student achievement, perhaps Lowell Milken (1998), the leader of a nonprofit group known as the Milken Foundation, said it best when he suggested, "For it is our experience and belief that technology, properly managed and applied, provides the opportunity to restore rigor to children's learning, to rebuild public confidence in American education, and to help ensure that the equality of opportunity in which we pride ourselves as a nation has meaning" (p. 2). At the same time, others who may be less convinced are crying out for more research to validate the enormous amounts of money being spent in efforts to push more technology into America's schools. One of the main arguments critics point to is the lack of quality research on the effectiveness of technology in improving student achievement.

Many experts point to the fact that current technology research is guilty of being inconsistent with methodologies and not using a proven framework for evaluation (Collins, 2004; Groff & Mouza, 2008; Jones & Paolucci, 1999). The use of technology varies so much from study to study as well as teacher to teacher that it is difficult to isolate variables that may effect student achievement (Frear & Hirschbuhl, 1999). Although the technology used in many studies is implemented under very narrow sets of conditions, it does not discount the fact that technology can make a positive difference on student achievement (Kimble, 1999). Not only is much of the research centered on narrow conditions, studies concerned with the effects of technology on student achievement make up only a small portion of technology research. For example, of the articles written in the Journal of Research on Teaching and Education from 1999-2003, only 9% of the articles focused on the benefits of technology-based teaching methods over non-technology-based teaching methods, and only 1% focused on ways to use technology already in place to increase student achievement (Robyler & Knezek, 2003). Nevertheless, the debate continues on whether or not technology can help improve student achievement.

For those critics who continue to argue against the effectiveness of technology, it cannot be overlooked that where technology has been ineffective, it can often be attributed to a failure to properly implement its use rather than a failure of the technology itself. One critic noted that anyone viewing a public high school in the last 50 years would discover that there has been very little change in teaching and learning for students as a result of computers or other forms of technology (Peck, Cuban, & Kirkpatrick, 2002). But, before determining the true effect technology has on student achievement, there are many factors that must first be considered and evaluated.

One such factor is the way in which computers are used by teachers (National Center for Education Statistics, 2005). One study concluded that 50% of teachers use computers only for low-level teaching such as drill and practice, 61% have students use technology for minimal tasks such as word processing and creating spreadsheets, and 2/3 of teachers polled felt they were not well prepared for using computers and the Internet in the classroom to influence student achievement (D'Amico, 2001; Peck et al., 2002). Another study found that only 1 out of 6 science teachers, 1 out of 8 social studies teachers, and 1 out of 9 math teachers reported that students used computers often in their class (Becker, 2000). This study found the most widespread use of technology by teachers was for such routine matters as writing lesson plans, calculating grades, and making handouts. Therefore, one may conclude that it is not the effectiveness of technology that is an issue, but rather how it is being used (Fletcher, 2006; Garthwait, 2001; Groff & Mouza, 2008; Robyler & Knezek, 2003). Way too often, technology in the classroom has been just another addition, rather than a powerful agent of change and improvement. Weglinsky (1998) noted that mere access and the frequency of use of technology do not automatically lead to improved student achievement.

A factor that contributes greatly to the difficulty of evaluating the effectiveness of technology is the amount of support provided within schools. As a result of the lack of support, technology is rarely implemented as intended in school systems. In 1999, the CEO Forum reported that more than 50% of schools in America are in the Low Tech category (as cited in D'Amico, 2001). U.S. firms spend at least $3,500 per worker per year for technology and support while schools spend about $122 per student (Kerrey & Isakson, 2000). The average amount of money spent on research and development is about .01% of the total budget in schools, while many IT firms usually spend around 10% of their total budget. For-profit companies have comprehensive tech support teams to ensure a proper infrastructure and adequate training; while most schools are lucky to have even one teacher or leader who is given time to serve as a tech support person within the building. Mann, Shakeshaft, Becker, and Kottkamp (1999) found in their study of schools in West Virginia that the use of technology had influenced student achievement in a positive way. A part of this success has been contributed to the fact that West Virginia spent nearly 30 cents of every dollar on technology training which is more than ten times the national average for schools.

While it is rare for schools to make an investment in technology professional development a priority, it may be even more rare in schools with a high concentration of poverty. And even when technology professional development is provided to schools, rarely does it consider teacher efficacy, instructional practices, personal computer use, or school characteristics such as teacher demographics, school culture and principal support. Schools that serve high numbers of poverty students, which are arguably the schools most in need of technology to improve student achievement, are often provided the least amount of resources. As Kati Haycock (2004), director of the Education Trust, pointed out, the organization of the education system in the United States is often structured so that we take students who have less to begin with and give them even less in schools, despite the abundance of research and experience that compel us to give them more, not less.

In California, districts with high concentrations of minority and poor students receive less funding than those with low concentrations and then even less money is spent on schools within these districts that serve high concentrations of minority and poor students. California spends approximately $310 fewer cost adjusted dollars per student in high poverty districts than in districts with the lowest concentration of low income students. Sadly, this disparity is not isolated to California. In New York, the gap amounts to approximately $2,615 dollars per student while in Illinois the gap amounts to approximately $2, 465 dollars per student (Education Trust, 2005). According to Roza and Hill (2003), the funding gap in Austin, Texas shows up when comparing teacher salaries. The teachers in the districts serving the lowest numbers of students in poverty earn an average of $3, 417 more per year. Texas districts also regularly assign a larger portion of their unrestricted funds to lower poverty schools (as cited in Education Trust-West, 2005). Obviously, with the noted disparities in funding, it may be even more difficult to find the necessary resources to implement technology professional development that results in technology integration in schools with high numbers of poverty students.

The United States is spending a significant amount of money on technology each year. Many contend this technology is not being effectively used to improve student achievement. Even more alarming is that the students most in need of assistance, those students in schools with high concentrations of poverty, are even further behind the technology revolution than those schools with lower concentrations of poverty. This becomes incredibly significant when the characteristics of poverty on school children are examined. Kennedy, Jung, and Orland (1996) determined that the relationship between the poverty status of families and achievement is not as strong as the relationship between the concentration of poverty in a school and achievement. Students who were not poor but attended schools with high poverty concentrations were found to be more likely to fall behind than poor students who attended schools with low concentrations of poverty.

If the concentration of poverty has such a powerful effect on student achievement, it is only natural to wonder if other things are not affected as well, such as characteristics of teachers or teaching practice.

Almost anyone in the school system would acknowledge more training and professional development is needed if technology is ever going to make a widespread difference in student achievement. Professional development is another means of supporting the proper implementation of technology (Saleh, 2008). A 1999 survey found that only 29% of teachers had participated in five or more hours of professional development in technology in the past year (Garthwait, 2001). Yet a report by the U.S. Congress indicated, “Helping teachers use technology effectively may be the most important step to assuring that current and future investments in technology are realized” (as cited in D’Amico, 2001). While everyone acknowledges the need for more comprehensive and long term professional development in this area, most school leaders and policy makers tend to avoid the commitment to the money, time and energy required to train teachers adequately. As a result of these factors and others, technology still has not seen widespread implementation in a way that makes a difference. Teaching still looks much like it did before technology ever entered the schoolhouse.

A comprehensive meta-analysis looking at technology’s ability or inability to improve student achievement was completed by Sivin-Kachala and later updated with the help of Bialo (2000). The two researchers reviewed more than 219 research studies on technology and achievement across all age groups. They found that students in technology rich environments experienced an increase in achievement in all major subject areas, showed increased achievement in preschool through higher education for both regular and special needs students, and showed improved attitudes toward learning and self-concept. Numerous other studies have been conducted and conclude that technology has a positive effect on student achievement. A study published by the North Central Regional Educational Laboratory (1999) cited research that supported the belief that technology applications can foster higher-order thinking by involving students in genuine, complex tasks within a collaborative context. Several studies have found that when technology is used, students are more likely to complete multiple revisions of papers, a well-known process for improving writing ability (Finkelman & McMunn, 1995; Owston & Wideman, 2001; Turner & Dipinto, 1992). Numerous other studies exist involving research by Becker, Cradler, and the U.S. Department of Education, all pointing to the positive effects technology can have on student achievement.

Despite substantial evidence that technology, when properly implemented, can positively impact student achievement, the critics of this same technology cannot be ignored. Perhaps the most well-known critic is Larry Cuban, a professor at Stanford University and the author of numerous reports addressing the use of technology in America's schools. Cuban points out that there are belief systems entrenched in schools that prevent teachers from doing much more than supplementing their traditional teaching practices. There are also organizational obstacles such as access and technical support that are major hindrances to the proper use of technology (as cited in Peters, 2002). Cuban (2001) suggests that the technology used in schools is nothing more than Internet use and word processing. He believes technology has only allowed teachers to do what they have always done before, such as average grades, communicate with parents and administrators, and assign research papers. He predicts that the goal of every student having his or her own computer will eventually be achieved, but yet will result in no fundamental changes in teaching practice.

Clark (1994) claims it is the method of instruction associated with the use of technology that causes gains in student achievement, not the technology itself. Jones and Paolucci (1999) reviewed over 800 journal articles and concluded that researchers have not clearly demonstrated measurable improvements in student achievement that can be associated with technology. “For the most part, large classrooms and schools go about their daily business ignorant of the profound changes caused by computing technologies in many other areas of everyday life, from new manufacturing practices to new scientific research methods, from new business practices to new methods for creating art and music” (Norris, Sullivan, Poirot, & Soloway, 2003, p. 15).

A 2002 report by the National Center for Education Statistics (NCES) claimed that the introduction of the Internet has not dramatically changed how teachers teach or how students learn. Even so, President Bush signed a bill shortly thereafter that provided for about one billion dollars in educational technology spending (Peters, 2002). The recent 2004 National Technology Education Plan published under Bush’s administration points out that the development of technology for education is booming, however the provision of technology without proper training and support has caused the promise of technology to be unrealized (U.S. Department of Education, 2004).

A “Snapshot Survey” of more than 4,000 K-12 teachers suggested the reason technology has not had an impact on teaching and learning is that students, for one reason or another, have not actually used technology (Norris et al., 2003). There is a general belief that technology has not had a significant impact on teaching and learning, despite the billions of dollars that have been invested. Therefore, when evaluating the use of technology to determine if it truly has an impact on student achievement, perhaps the most critical factor to be observed is the classroom teacher.

The research consistently points back to the teacher as one of the most influential factors in determining whether or not a technology program is successful (Quinn & Valentine, 2004). Technology is most effective when teachers are allowed to decide the best way to use technology in a particular context, and teachers are allowed to engage in the training to do so (Kimble, 1999). Critics and supporters alike recognize the value of technology when properly implemented. Most everyone agrees that for this to happen, ongoing professional development must occur (Garthwait, 2001; Lord, 2002). This professional development must include: understanding how learning and instruction should change to best use the technology (Kimble, 1999); learning practical applications of technology (NCREL, 1999); and the time and resources necessary to practice and implement technology (Quinn & Valentine, 2004). Preparing teachers, continuing professional development and ongoing readily available technical assistance are critical to effective technology programs (Cradler & Bridgforth, 1996).

An often overlooked aspect concerning teachers is the "style" of teaching most conducive to the integration of technology. Honey and Moeller (1990) contend that a teacher with a student-centered philosophy versus a teacher-centered philosophy is more likely to be able to effectively use technology in the classroom. According to Wang's (2002) research, computers were more successful at improving student learning when used by teachers who used more student centered instructional techniques. He further pointed out that computers play a very limited role when under the supervision of those teachers with a more teacher-centered approach to teaching.

While the research continues to build on the importance of student-centered instruction as a critical factor in determining the effect of technology on student achievement, many teachers are still not comfortable with this style of teaching. And while many teaches are not comfortable with this style of teaching, the deficiencies may be even more pronounced in schools serving high numbers of poverty students. These schools tend to use technology for more traditional remediation and skills practice. A nationwide study found that the use of technology in low SES schools consisted mainly of the reinforcement and remediation of skills while higher SES schools use technology to analyze information and present information to audiences (Becker, 2000). Solomon, Battistich, and Horn (1996) found, in a study of 476 teachers in 24 urban and suburban elementary schools, that teachers in high poverty schools put less focus on constructivist style, less emphasis on intrinsic motivation, and involved students less in active discussions and explorations.

Another factor related to the implementation of innovations such as technology is a teacher's sense of efficacy. Tschannen-Moran, Woolfolk, and Hoy (1998) define a teacher's sense of efficacy as "the teacher's belief in his or her capability to organize and execute courses of action required to successfully accomplish a specific teaching task in a particular context" (p. 22). Citing numerous research studies, they noted that a teacher's sense of efficacy is related to student outcomes such as student achievement and motivation. It is also related to a teacher's behavior in the classroom, their openness to new ideas and willingness to experiment with new methods of teaching.

Because a teacher's sense of efficacy can be a predictor of their willingness to implement new innovations, such as technology or teaching methods conducive to integrating technology, it must also be considered when designing professional development for teachers. It is also very important to note that there are certain characteristics within a school that may have an effect on a teacher's sense of efficacy. For example, because the conversations among teachers in schools with high numbers of poverty students may be more likely to focus on the extreme difficulties of educating their students, a teacher's sense of efficacy may be affected in a negative way. (Tshannen-Moran, et al., 1998). It is important to remain aware of the effects of a school's student population on the efficacy of teachers which may in turn affect teachers' willingness to adopt new innovations.

Whether or not technology improves student achievement has been a hotly debated question for more than twenty years now. In fact, dating all the way back to Thomas Edison's claims in 1913 that the motion picture would revolutionize education, educators and policy makers have made attempts to determine whether or not the expenditures on technology can be justified. Substantial evidence exists that technology can have a positive effect on student achievement. What is unclear is how often it is truly used in an environment supportive enough for the technology to realize its ability to improve student achievement. The 2004 National Technology Plan called for strengthened leadership, innovative budgeting, improved teacher training, support of E-learning and virtual schools, broadband access, integrated data systems, and the move toward digital content (U.S. Department of Education, 2004).

> Under the right conditions, where teachers are personally comfortable and at least moderately skilled in using computers themselves, where the

> school's daily class schedule permits allocating time for students to use computers as part of class assignments, where enough equipment is available and convenient to permit computer activities to flow seamlessly alongside other learning tasks, and where teachers' personal philosophies support a student-centered, constructivist pedagogy that incorporates collaborative projects defined partly by student interest, computers are clearly becoming a valuable and well-functioning instructional tool (Becker, 2000, July, p.2).

Therefore, the question to be asked about technology and America's schools is not whether or not technology is able to improve student achievement. Under the right conditions, numerous studies have demonstrated technology can and does impact student achievement (Kimble, 1999; Milken, 1998; Sivin-Kachala & Bialo, 2000; Weglinsky, 1998). The real question is not whether or not technology has the capability of impacting student achievement. The more meaningful issue is what must be done to provide the support to equip teachers with the necessary skills to use technology in a way that truly does impact student achievement.

Problem Statement

The Technology Purchasing Forecast 2002-2003 8th edition published by Quality Education Data reports that technology spending for U.S. public schools was 6.45 billion dollars in 2001-2002 and reached 7.185 billion dollars in 2002-2003 (Press Release, 2002). By 2006, this number was projected to have reached 9.5 billion dollars (Kane, 2006). Teachers and schools have been purchasing computers for more than two decades and numerous professional development opportunities have been provided, yet much of the research says computers are still not making the impact on student learning they are capable of making (Caverly, Peterson, & Mandeville, 1997; Trotter, 1998, as cited in Flowers & Algozzine, 2000; Oppenheimer, 2003; Wetzel, 2001). Strommen (1992) claimed that technological changes that have affected society have left education unaltered and unchanged (as cited in Royer, 2002). If technology is going to be truly integrated into education to affect student achievement, then the focus must be on training teachers effectively to use technology.

Commissioned by the United States Congress in 1995, the Office of Technology Assessment stated that helping teachers "effectively incorporate technology into the teaching and learning process is one of the most important steps the nation can take to make the most of past and continuing investments in educational technology" (as cited in Parr, 1999, p.280). Schofield (1995) emphasizes that one of the main reasons computers have not lived up to their potential is because no one has shown teachers how to use new technology or trained teachers on how computers can be incorporated into their students' learning process (as cited in Caverly, et al., 1997).

While there has been much research on what teachers do not have in the area of technology such as adequate training or professional development, access to computers, time, and support, it is equally important to research what teachers do have. What teachers do have are certain beliefs about pedagogy, student achievement, learning, and other intrinsic thought patterns that may have a profound effect on a teacher's ability or willingness to integrate technology. If teachers are expected to implement technology in ways that impact student achievement, there is a significant need for more research in this area.

Purpose of the Study

With limited school funding and an increased emphasis of improving student achievement for every child, expenditures that were once "automatic" must now be subjected to intense scrutiny. Before investing more money in hardware and more money in technology related professional development, more research is needed. The purpose of this study is to determine if the level of technology implementation by teachers is related to the following: teachers' level of current instructional practices; teachers' level of personal computer use; the concentration of poverty within a school; teacher efficacy; school culture; principal support; and demographic characteristics including gender, age, attainment of an advanced degree, and years of classroom teaching experience.

Research Questions

1. Is there a relationship between the level of current instructional practices and the level of technology implementation in a Southwestern school district?
2. Is there a relationship between the level of personal computer use and the level of technology implementation in a Southwestern school district?
3. Is there a relationship between the poverty concentration within a school and the level of technology implementation Southwestern school district?
4. Is there a relationship between the level of teacher efficacy and the level of technology implementation Southwestern school district?
5. Is there a relationship between each of the following demographic characteristics and the level of technology implementation in a Southwestern school district:
    a. gender of the teacher
    b. age of the teacher
    c. attainment of an advanced degree by the teacher
    d. years of experience of the teacher

e. school culture

f. principal support within the school?

Significance of the Study

As technology expenditures continue to increase and constitute a significant portion of school budgets, it becomes increasingly important to understand how to best support teachers in the implementation of technology into their classroom. According to Part D (Enhancing Education through Technology Act of 2001) of Title I of the No Child Left Behind Act, the following national goals have been established for technology:

1. Provide assistance for the implementation and support of a comprehensive system that effectively uses technology to improve student academic achievement

2. Improve student academic achievement through the use of technology in elementary and secondary schools

3. Assist every student in crossing the digital divide by ensuring that every student is technologically literate by the end of eighth grade

4. Encourage 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.

As this portion of federal law indicates, one of the most critical aspects to ensure that technology truly does impact student achievement involves teacher training as it relates to instructional methods. It is often assumed that educators enter the profession of teaching already knowing how to use technology, and that they have the ability to effectively integrate technology into their classrooms (Flowers & Algozzine, 2000). However, upon closer review, it is important to note that teachers with fifteen years of service did not even experience computers in their teacher training (Kinnaman, 1990, as cited in Hope, 1997). Even those teachers with less years of experience who did encounter computers often only received one course or workshop in the area of technology.

Furthermore, Oliver (1993) discovered that teachers who had formal training to learn to use the computer as a personal tool did not differ from beginning teachers who had no training. He suggested that the possibility is strong that there is something besides technical knowledge and skill that cause teachers to effectively integrate technology. While many professional development efforts have addressed training teachers in the technical knowledge and skill of technology, far fewer have addressed how teacher beliefs and instructional practices are related.

A barrier often ignored is the aspect of change. When teachers are asked to integrate technology, they are asked first to learn new teaching tools such as the computer and the Internet. More importantly, though, they are asked to change the way they teach their students, which is at the heart of a teacher's purpose. The concept of first and second order changes best describes the obstacles teachers are facing when asked to integrate technology. Much of the research is focused on what are considered first order barriers such as the number of computers in a classroom, the amount of software available, or technical support for computer problems. These types of barriers do not typically challenge beliefs about current instructional practices or other deeply held values (Ertmer, Anderson, Lane, Ross, and Woods, 1999).

First order barriers are more easily observed and perhaps more easily addressed, which may be an indication of why more research has been conducted in this area. Second order barriers are more difficult to determine and therefore more difficult to address. Changing second order barriers often requires major changes in deep seated beliefs and values, such as changing from a traditional teaching style to a more constructivist teaching style (Sandholtz, Ringstaff, & Dwyer, 1997). Second order barriers are an essential part of teachers' beliefs about teaching, beliefs about computers, beliefs about classroom practices, and response to change (Ertmer et al., 1999; Mueller, Wood, Willoughby, Ross, & Specht, 2008).

While much research has been done to address first order barriers to the successful integration of technology, much more research is needed to address second order barriers to technology integration. Instructional practices, personal computer use, teacher efficacy, and school characteristics such as poverty concentration, school culture, and principal support all have the potential to hinder or promote the integration of technology in schools (Chen, 2008). It is essential to gain a better understanding in these areas in order to better address these needs through teacher training and professional development. Without more understanding, these needs will continue to serve as major barriers to integrating technology. Without more understanding, the large expenditures on technology will never accomplish significant improvements in student achievement. Without more understanding, teachers will continue to be ill prepared to use technology to address the almost insurmountable challenge of improving student achievement for all students.

This study attempts to provide local school districts with information that will improve their ability to meet the national goals for the use of technology. Also, decisions regarding money and resources allocated for professional development and training for teachers are sure to be influenced by the results of this study. Finally, this study goes beyond the concept of the Digital Divide by looking into the impact of the poverty concentration within a school. Most research and information concerning the Digital Divide has focused on fiscal resources. This particular study will focus on determining potential relationships between the level of technology implementation and the following independent variables: current instructional practices; personal computer use; teacher efficacy; the poverty concentration within a school; school culture; principal support; and demographic characteristics including age, gender, years of experience, and the attainment of an advanced degree.

Definitions

1. Professional (staff) development - Professional development is the processes and activities designed to enhance the professional knowledge, skills, and attitudes of educators so that they might in turn, improve the learning of their students (Guskey, 2000, as cited in Reitzug, 2002, p.2).

2. Teacher's Sense of Efficacy - A teacher's belief in his or her capability to organize and execute courses of action required to successfully accomplish a specific teaching task in a particular context. (Tschannen-Moran, Woolfolk Hoy, and Hoy 1998, p.22). For the

purposes of this study, teacher efficacy and teacher's sense of efficacy may be used interchangeably.

3. Poverty concentration - The percentage of students in a particular school who qualify for free or reduced lunch prices. To be eligible for free lunch, a student must be from a household with at income at or below 130 percent of the federal poverty guidelines. To be eligible for a reduced-lunch price, a student must be from a household with an income at or below 185 percent of the federal poverty guidelines.

Assumptions

The following assumptions related to this study were made by the researcher:

1. Participants understood the questions on the survey instrument and answered the questions honestly and accurately.

2. The survey used provided valid and reliable answers to the proposed research questions.

Limitations

This study was limited by the following factors:

1. This study did not consider the presence or frequency of use of various software programs.

2. This study was based on elementary schools, in one district, in one state, located in the Southwestern United States. This district was located in a community with a major research university.

3. This study explored possible relationships among variables. Potential relationships among variables cannot be assumed to imply cause and effect relationships. It is also

possible that unexamined variables may also contribute to level of technology implementation by teachers.

4. Except for the poverty concentration, all data are self-reported data. Self-reported technology surveys completed by teachers may produce data that is inaccurate if teachers report their use of technology at a more desirable level than which they are actually operating (Sullivan, 2007). However, self-reported technology surveys are the most common method used to gather data from teachers regarding instructional practices and technology use (Bielefeldt, 2002).

Summary

This chapter has provided a preliminary look at the effect technology can have on student achievement. In addition, it has also touched on a few of the most formidable barriers to ensuring teachers implement technology into the classroom in a way that will improve student achievement. The chapters that follow will attempt to build on the information contained in this chapter in an effort to impact the current body of knowledge regarding the teacher characteristic of efficacy, the effects of the poverty concentration within a school, instructional practices, technology implementation, and information to be considered when designing professional development to improve the level of technology implementation.

CHAPTER II

LITERATURE REVIEW

Introduction

The purpose of this chapter is to review the pertinent literature regarding the following: the effects of technology on student achievement; the current levels of technology implementation by school teachers; teachers' sense of efficacy; instructional practices; technology and professional development; personal computer use; the challenge of poverty; and the importance school culture. The review of the literature will provide a background to establish the information obtained through the administration of the survey instrument in an attempt to answer the five proposed research questions.

Background

One problem associated with researching educational technology is that when technology is introduced into the classroom, many other variables change as a result. Teacher perceptions can change, teaching strategies can change, and student attitudes can all change (NCREL, 1999). As a result of such changes, it is difficult to identify the new technology as a true independent variable. It is also extremely difficult to use standardized test scores, a measure often used as a gauge for success in education, to determine the effectiveness of technology. The link between the two is not a natural one (NCREL, 1999). Also, because technology has grown so rapidly, perhaps it has surpassed the current knowledge of how to use technology to improve student achievement (Allen, 2001). Research is needed to help guide the ways technology is implemented in order to have a positive impact on measures such as achievement, retention, and student satisfaction (Robyler & Knezek, 2003).

Technology's Effect on Student Achievement

In researching the effectiveness of technology on student achievement, there are six studies that are common in most of the literature. The first is Mann's study of the West Virginia Basic Skills/Computer Education (BS/CE) program. The data included a sample of 950 fifth grade students from 18 elementary schools across the state in 1991-1992. Data was also collected from 290 teachers. The Integrated Learning System technology concentrated on teaching spelling, vocabulary, reading, and math. The study found that the more students used the BS/CE program that year, the more their test scores increased on the Stanford 9. The study concluded that the technology accounted for as much as 11 % of the improvement on basic skills scores that year. Researchers also concluded that the cost of the program was much more cost effective at about $86 per student than the state's effort to reduce class sizes at a cost of $636 per student. They claimed the BS/CE program was more cost effective than lowering class sizes from 35 to 20, increasing instructional time, and cross-age tutoring (Cradler, McNabb, Freeman, & Burchett, 2002; Garthwait, 2001; McCabe & Skinner, 2003; Schacter, 1999).

A second major well known study is Harold Weglinsky's (1998) study on the effects of technology on students' math scores according to the 1996 National Assessment of Educational Progress (NAEP). He assessed the effects of simulation and higher order thinking technologies on a national sample of 6,227 fourth graders and 7,146 eighth graders, controlling for socioeconomic status, class size, and teacher characteristics. Eighth grade students who used the software made gains up to 15 weeks above grade level. Eighth grade students whose teachers received professional development on computers showed gains in math scores up to 13 weeks above grade level. Higher order uses of computers and professional development were positively related to students' academic achievement in math for both fourth and eighth grade students. Also, fourth grade students who used computers to play learning games and develop higher order thinking performed 3 to 5 weeks ahead of students who did not use technology. Forgasz (2003) also found that technology enhanced student understanding of mathematical concepts through the use of the Geometers' Sketchpad and Graphmatica. One negative correlation noted was the effects of the use of drill and practice technology; students who used these programs performed worse than students who did not.

A third major well known study was performed by researchers at Westat. This study analyzed student scores on two criterion referenced tests given to Illinois 8th graders and 11th graders during the 1998-1999 school year. After controlling for poverty, they found that technology had a small but significant impact on student achievement. Westat found that where teachers' use of technology to facilitate or enhance classroom instruction was high, standardized test scores were also high. Researchers found the effect of technology to be strongest on the 11th grade science scores. A strong relationship was also found for the 10th grade reading assessment, 8th grade writing assessment, and 11th grade social science assessment. The impact of technology was found to be generally stronger at higher grade levels. Also, 3/5 of principals and 56% of teachers indicated that integrating technology into the curriculum improved student achievement (as cited in Sherry & Jesse, 2000; Silverstein, Frechtling, & Miyaoka, 2000).

A fourth well known study is the eMINTS project in Missouri. In 2002, fourth graders in Missouri participated in a program that incorporated a wide array of multimedia and computer technology. Students who participated in the program consistently scored 10 to 13 points higher on Missouri assessment program tests than the students who did not participate in eMints. It is important to note, however, that similar results were not found in a study of third graders (as cited in McCabe & Skinner, 2003; Apple Computer, Inc., 2002).

A fifth well known and oft cited study was sponsored by Apple Computer. The study, known as Apple Classrooms of Tomorrow (ACOT), was performed over a 10 year period. It involved collaboration between public schools, universities, and researchers. Apple provided the necessary resources to saturate the students' environment with technology, including both home and school environments. The study looked at five different classrooms in five different schools. The results did not show an improvement in standardized testing, but it did show improvements in such areas as higher level reasoning and problem solving skills. Also, students were more likely to become independent learners and self starters. Another dimension was that the students with the access to technology had improved attitudes, improved attendance and a lower drop-out rate. The absenteeism in the ACOT classes was about half that of the normal student body and there were no drop-outs while the average drop-out rate for the normal student body was about 30% (Apple Computer, Inc., 2002).

The ACOT study suggested the following: students can learn reading, writing, and arithmetic if allowed to practice basic skills with technology; students are more engaged when technology is present; technology offers a way for teachers to individualize instruction; technology can decrease absenteeism, lower dropout rates, and motivate students to continue on to college; and students who regularly use technology take more pride in their work, have greater confidence in their abilities, and develop higher levels of self-esteem.

A sixth study was a meta-analysis of more than 500 studies on computer assisted instruction (CAI), conducted by James Kulik (1994). During more than fifteen years of research, Kulik found that students in the treatment groups scored at the 64th percentile on standardized tests while students in the control groups scored at the 50th percentile. He also concluded that CAI was more time efficient and improved student attitudes toward learning (as cited in Kimble, 1999).

Numerous other studies have been conducted and conclude that technology has a positive effect on student achievement. While these studies are some of the most comprehensive studies found in the research, numerous others have shown positive results as well (Fluellen, 2003). While it would be beyond the scope of this paper to mention all of these studies, it is important to mention a number of them to emphasize the potential for technology to impact student achievement in a positive way. A study published by the North Central Regional Educational Laboratory cited research that supported the belief that technology applications can foster higher-order thinking by involving students in genuine, complex tasks within a collaborative context (1999). Several studies have found that when technology is used, students are more likely to complete multiple revisions of papers, a well-known process for improving writing ability (Finkelman & McMunn, 1995; Owston & Wideman, 2001; Turner & Dipinto, 1992).

Yuen-Kuang Liao conducted a meta-analysis of 35 studies and found that the use of hypermedia had a moderately positive effect on student achievement, with an effect size of .48, over that of traditional instruction (as cited in Garthwait, 2001). In 1999, researchers studied Idaho's computer infusion initiative using a sample population of more than 35,000 8th and 11th grade students. They concluded that the integration of technology resulted in improvement in language, math, and reading, as determined by test score gains (Fouts, 2000). Researchers from the U.S. Army Research Institute and Boise State University examined more than 200 research studies and found that when properly implemented, technology had a significant effect on student achievement as determined by test scores in all subject areas and all ages (Maryland State Board of Education, 1999). They also concluded that technology increased student-teacher interaction, increased levels of cooperative behavior, and resulted in better attendance, lower dropout rates and higher rates of college attendance. They further noted that the use of technology is particularly effective on students of poverty.

An eight year study of students' SAT scores at Brewster Academy showed students who used laptop computers on a regular basis increased their combined SAT score by an average of 92 points (The Endeavour Group, 2003). Follansbee, Hughes, Pisha, and Stahl (1997) studied more that 500 elementary and middle school students from seven large urban school districts in 28 different classes. The students were given an assignment on civil rights and 14 classes were allowed to use online resources while 14 were not. The students allowed to use online resources performed better in all nine of the established criteria. Five of the higher scores were statistically significant. The 2004 National Technology Education Plan reports on a district in south central Alaska. The district uses technology to enhance student learning, improve technology skills, and increase efficiency of administrative tasks. The use of the Internet by students increased from 5% in 1998 to 93% in 2001. On the California Achievement Test, reading scores improved from the 28th percentile in 1995 to the 71st percentile in 1999. At the same time, math scores improved from the 54th percentile to the 78th percentile and language arts scores improved from the 26th percentile to the 72nd percentile (U.S. Department of Education, 2004)

Teachers' Level of Technology Implementation

In spite of the commitment to technology in schools, it often seems many teachers still use computers to support their current instructional practices rather than as a tool to transform their teaching into more innovative and constructivist practices (Cuban, 2001; VanFossen & Waterson, 2008). Before teachers can effectively implement technology, a change in pedagogy must take place. According to Conlon (2000), the following is more of an indication of what is really happening inside our classrooms:

> Outside of school the media grabs for attention with a stream of Technicolor images featuring global heroes and sound bites. Inside the school the standard fare comprises monochrome worksheets and unheroic talking heads. If the school is perceived as not only imposed and inflexible but also outdated and dull, then its ability to persuade postmodern youth to swallow their curriculum medicine will be limited (p.112).

Despite teachers not being effectively trained for technology integration, the National Council of Teacher Education's Task Force on Technology and Teacher Education (1997) states, "Classroom teachers hold the key to the effective use of technology to improve learning. But if teachers do not understand how to employ technology effectively to promote student learning, the billions of dollars invested in educational technology initiatives will be wasted" (as cited in Jayroe, Ball, & Novinski, 2000, p. 12).

Studies conducted in 1996 by the Department of Commerce reported that only half of all U.S. teachers had used a computer at all (Office of Technology Policy, 1996, as cited in Flowers & Algozzine). A Department of Education report and McKenzie (1999) both report that only 20% of full time public school teachers feel ready to integrate technology into their classroom (Education Digest, 1999, as cited in Guhlin, 2001). In another study, 84% of teachers reported having access to the Internet, yet 2/3 of them stated that the Internet is not well integrated into their classroom (Net Day, 2001, as cited in Cradler et al., 2002). Numerous other reports have found that teachers are not making use of the technology available to them in their classrooms (Eteokleus, 2008; Fletcher, 2006; Guhlin, 2001; Kober, 1994, as cited in Parr, 1999; McKenzie, 2001; Rowand, 2000; Starr, 2000; Yildirim, 2000). Becker and Ravitz (2001) found that only 25 % of secondary English teachers, 17 % of science teachers, 13 % of social studies teachers, and 11 % of math teachers make use computers on a weekly basis in the classroom (as cited in Mouza, 2002/2003).

One widely held belief has been that if schools provide enough resources such as money, computers, and software, teachers will integrate technology into their classrooms (Sugar, 2002). This has not been the case in every situation. Increased access to technology does not necessarily result in an increase in the use of technology by teachers (Forgasz, 2006; Guhlin, 2001). Many schools lack the infrastructure to support true integration of technology, despite the large sums of money that have been spent on obtaining technology (Fletcher, 2006; Royer, 2002). Teachers' personal beliefs are believed to have a great influence on the use of particular technologies (Hermans, Tondeur, Van Braak, & Valcke, 2008; Sugar, 2002; Wen & Shih, 2008). These personal beliefs may very well include teacher efficacy, beliefs about instructional practices, beliefs about the use of technology, and a teacher's beliefs about his or her students.

Studies have shown that math teachers have been slow to integrate technology even when they had quality hardware accessible to them (Rosen & Well, 1995, as cited in Norton, Campbell, and Cooper, 2000). In a case study of math teachers in a private school of about 650 students with a student to computer ratio of 4 to 1, the authors of the study found that technology resources in a school do not mean that the mathematics staff will use technology in their teaching (Norton et al., 2000). Sheingold and Hadley (1990) surveyed teachers who had integrated technology into their teaching and found that having more technology did not in itself cause teachers to begin using technology. These teachers indicated that they spent much of their own time and effort to learn how to integrate technology (as cited in Marcinkiewicz, 1993/1994).

In 1991, at a large private secondary school, a five-year program was begun to increase the use of computer technology. Each teacher was provided a laptop computer and in-service programs were offered. The use of computers in the classroom remained relatively unchanged. The school then added more technical staff and provided technology coaches for all staff and only then did the use of computers increase. In a 1996/1997 study of a school that had just installed a large computer network, 26% of the teachers reported that computers had not changed their teaching because of their lack of access to the computer network and the software (Wishart and Blease, 1999). This study suggests what much of the other literature suggests; technology access in and of itself does not necessarily lead to increased technology integration. There are other factors to be considered.

Teacher Efficacy

One such factor to be considered is teacher efficacy. A tremendous amount of research indicates that, "teachers are more hesitant and less likely to embrace computer technology than other professionals" (Paprzycki & Vidakovic, 1994, as cited in Yildirim, 2000, p. 480). One of the results of any needs assessment is likely to be that many teachers do not value the use of technology, and they may even fear the use of technology. It is important to realize that technology integration can affect job performance, the psychological well being of employees, interpersonal relationships, organizational effectiveness, and the organizational climate and culture (Salanova, Grau & Peiro, 2000, as cited in Llorens, Salanova, & Grau, 2002/2003). And to make things worse, the "training" model that is often used to teach technology integration results in a large number of skills being presented over a short period of time and leaves little time for teachers to become comfortable and confident in the use of new skills. This leaves teachers feeling resistant, anxious, and reluctant (McKenzie, 2001).

Teachers' beliefs either assist change and innovation or serve as an obstacle to inhibit change and innovation (Dexter, Anderson, & Jay, 1999; Ertmer, 2005; Judson, 2006; Levin & Wadmany, 2006; Schuttloffel, 2000, as cited in Chuang, Thompson, & Schmidt, 2003; Wetzel, 2001). Teacher attitudes, time to plan, access, and professional development are all critical to improving technology integration (Guhlin, 2001; O'Dwyer, Russell, & Bebell, 2006). Falk (1987) suggests that teachers choose to refrain from using computers because it causes them to question their existence as educators (as cited in Hope, 1997). This attitude is likely to increase with the onset of online courses for high school credit.

A discouraging study of 61 innovative programs in 146 districts nationwide by Crandall and Associates (1982) found that attempts to alter teacher attitudes and gain commitment to new practices, such as technology integration, were generally unsuccessful prior to the implementation of the innovation (as cited in Guskey, 1985). Schools have spent too much time and too much money running teachers through “training” activities in which skills are introduced in short sessions and out of context (McKenzie, 2001).

While many studies have focused on the lack of skill and knowledge of teachers as a factor in the lack of use of technology, Becker (1999) and Fullan (1996) both focus more on the beliefs of teachers (as cited in McKenzie, 2001). It is suggested that the way teachers think and believe about pedagogy and teaching preferences influence the way technology is designed and used (Dede, 1999, as cited in Wetzel, 2001; Ertmer, 1999, as cited in Sugar, 2002; Norton et al., 2000; Semple, 2000; Smylie, 1995, as cited in Reitzug, 2002.; Wetzel, 2001). For teachers to change their teaching strategies, they must become dissatisfied with their existing conditions and see change as a viable option (Posner, Strike, Hewson & Gertzog, 1982, as cited in Wetzel, 2001). For any change to become embedded, teachers must be allowed to work through how it will fit into their current system and set of beliefs.

> Simplistic views of technology integration and change underestimate the impact teachers’ beliefs have on how they teach, they simplify the process of how teachers develop and learn professional knowledge, and they divert the examination of how social norms and structures might support or contradict a proposed change (Dexter et al., 1999, p.237).

It is important to realize that not only do the individual beliefs and values of teachers about teaching and learning affect technology integration, the organizational culture and climate may also inhibit or promote technology integration (Becker, 1991, Dexter et al., 1999, & OTA, 1995, as cited in Wetzel, 2001; Chen, 2008; George et al., 1996, as cited in Guhlin, 2001; Norton et al., 2000).

Guskey (1986) argues that changes in the beliefs and attitudes of teachers, and thus the likelihood of changes in practice, only occur after teachers are able to observe the impact of the changes on student outcomes. It is of critical importance that change efforts focus on providing teachers feedback on learning outcomes. When teachers see that a new innovation, such as technology integration, works in their classroom, their beliefs and attitudes can and will change for the better (Guskey, 1985).

An important aspect of teacher beliefs, or attitude, is a teacher's sense of efficacy. Using the work of Rotter, the idea of teacher efficacy was first proposed by Rand researchers. The Rand research asked teachers to state their level of agreement with two questions. The two questions essentially asked teachers how much control they have over student motivation and performance compared to the student's home environment and whether or not a teacher's level of effort would enable them to get through to even the most difficult or unmotivated students. Based on this research, a definition of teacher efficacy was developed addressing the degree to which a teacher feels he or she has the means to affect student performance (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998).

In addition to the work of the Rand researchers, a second body of information emerged concerning teacher efficacy. The second body of work was based on Bandura's work and identified teacher efficacy as a type of self-efficacy. In the early 1980s, Gibson and Dembo (1984) combined the work of the Rand studies with the work of Bandura to develop a 30 item measure of teacher efficacy. Through the use of this survey, Gibson and Dembo were able to predict that teachers with high scores on their efficacy scale would be more active and confident in their responses to students and that these same teachers would persist longer, provide a greater academic focus in the classroom, and provide different types of feedback to students when compared to teachers with lower scores on the efficacy scale.

Prior to a continued look into the idea of teacher efficacy, it is important to distinguish teacher efficacy from the concept of self-esteem. Efficacy is specific to a particular context or task. "Self-esteem usually is considered to be a trait reflecting an individual's characteristic affective evaluation of self (i.e. feelings of self-worth or self-liking). By contrast, self-efficacy is a judgment about task capability that is not inherently evaluative. A person may feel hopelessly inefficacious for a particular activity, such as figure drawing or downhill skiing, and suffer no diminishment of self-esteem because that person has not invested self-worth in doing that activity well" (Gist and Mitchell 1992, p. 185). Guskey and Passaro (1993) further defined teacher efficacy as "teachers' belief or conviction that they can influence how well students learn, even those who may be considered difficult or unmotivated" (p. 3).

Tschannen-Moran, et al. (1998) suggest that teacher efficacy is determined by a comparative judgment on whether his or her abilities and strategies are sufficient for the task at hand, as it relates to teaching. So, teachers may feel efficacious in one context such as lecture, yet feel quite inefficacious in the area of technology integration. Based on this, they defined teacher efficacy as a "teacher's belief in his or her own capability to organize and execute courses of action required to successfully accomplish a specific teaching task in a particular context" (P. 22). It will be this definition that is the focus of this research.

Besides defining teacher efficacy, it is important to consider what the research says about how teacher efficacy can be used to learn more about certain characteristics of teachers. In an interview conducted by Shaughnessy (2004), Anita Woolfolk Hoy noted that a teacher's sense of efficacy has proven to be an important characteristic of teachers that can be correlated to positive student and teacher results. Citing numerous researchers and related studies, Tschannen-Moran, et al. (1998) emphasized that a teacher's sense of efficacy is related to student outcomes such as student achievement and motivation. They also emphasized the relationship between a teacher's sense of efficacy and the following teacher behaviors: behavior in the classroom; effort put forth; goals; level of aspiration; openness to new ideas; willingness to try new methods to better serve their students; level of persistence when things do not go smoothly; resiliency in the face of difficulty; enthusiasm for teaching; level of commitment; and the likelihood a teacher will remain in the field of teaching. A teacher's sense of efficacy is so powerful that it may even be related to school climate, an orderly and positive school atmosphere, and the ability to overcome the effects of socioeconomic status on student achievement. This particular idea of "collective efficacy" has been the subject of very little research. This study intends to contribute to the research on "collective efficacy" by examining teacher efficacy within a school, as it relates to the poverty concentration.

Allinder (1994) determined that teacher efficacy correlates to a teacher's willingness to experiment with new and varied instructional approaches, a desire to discover better ways of teaching, and the likelihood of implementing innovative and progressive methods. He also found that the level of planning, organization, and enthusiasm was all related to a teacher's sense of efficacy.

The Rand Corporation's Change Agent Study found teacher efficacy to be the most powerful predictor in determining program implementation success (Berman & McLaughlin 1977). Guskey (1998) found teacher efficacy to be related to student achievement and motivation, teachers' adoption of innovations, classroom management strategies, and school effectiveness.

In addition to the intrinsic characteristics of teachers associated with teacher efficacy, many studies have suggested a link between a teacher's sense of efficacy and student achievement. In the 1976 Rand Study, teacher efficacy was found to be strongly related to the differences in reading achievement of minority students as a part of various reading programs and interventions. In a study of second and fifth graders who had teachers with a greater sense of efficacy, Moore and Esselman (1992) found that these students outperformed their peers in math on the ITBS test. In a study of the results on the Metropolitan Achievement Test at four secondary schools, the Rand researchers found that teacher efficacy accounted for 24% of the variance in math achievement and 46% of the variance in achievement on the language portion of the test. Finally, Guskey (1998) suggested that teacher efficacy is closely related to a number of important variables which include both student achievement and motivation.

If teacher efficacy is valued as a predictor of certain characteristics of teachers and if there is a potential relationship between a teacher's sense of efficacy and student achievement, then it is important to further research the possible relationship between a teacher’s sense of efficacy as it relates to technology implementation and instructional practices.

Instructional Practice

Hurst (1994) opined, “I firmly believe that computer technology can never replace teachers. As a colleague once told me, computers are nothing more that a new kind of chalkboard, a tool to help teachers make their instruction more effective and learning more inviting for a generation weaned on Nintendos, VCRs and home PCs” (p.74). Veenema and Gardner concluded, “Technology does not necessarily improve education. It could become a valuable tool, but only if we use it to capitalize on our new understandings of how the human mind works” (as cited in McKenzie, 2000, p.2). As these two statements indicate, success with technology implementation is not solely the result of technology, but rather how teachers integrate technology into their current practice. Teachers tend to teach in the way they were taught (Semple, 2000). They tend to focus on “instruction” which conveys a very directed and controlled approach which was a characteristic of earlier pedagogical beliefs and computer use (Boyle, 1997, as cited in Royer, 2002). Many teachers continue to hold traditional beliefs about classroom instruction and teaching and continue to incorporate technology in a didactic manner. Cuban (2000) points out computers are often used for memorizing facts rather than promoting higher-order thinking skills. Such techniques and beliefs have unfortunately resigned technology in many classrooms to little more than a word processor or tool for other low level applications rather than transforming the way teachers teach.

As mentioned earlier in this review, many teachers are not using computers in their classroom. However, even those who are using computers are not using them as tools to help students better understand difficult concepts or to enhance current teaching practices (Becker, 1997, as cited in Norton et al., 2000; Doherty & Orlofsky, 2001, & Becker, 2001, as cited in Mouza, 2002/2003; Lei & Zhao, 2007; Papert, 1980, as cited in Royer, 2002). Schrum (1995) explains the lack of technology integration by contending that universities and schools have not supported "the thoughtful use of technologies to enhance the teaching and learning process" (as cited in Schnackenberg et al., 2001, p.138).

For teachers to implement any new instructional strategy, they must acquire new knowledge about it and weave it together with the demands of the curriculum, classroom management and existing instructional skills (Chai & Merry, 2006; Dexter et al., 1999; Guhlin, 2001; Painter, 2001). Technology integration requires knowledge of technology, but it also requires that teachers be able to plan and execute a good lesson (Painter, 2001). Educators are aware of the expanding role and influence of technology, yet they have struggled to find appropriate uses of technology in the classroom. Unfortunately, conventional teaching techniques do not conform to the more traditional techniques to which many teachers have become accustomed (Mouza, 2002/2003). In a case study of a math staff in a private girls school with about 650 students and a computer ratio of 4 to 1, resources were not used because the activities implicit with the use of technology did not support the teachers' preferred teaching strategies (Norton et al., 2000).

Becker (1999) points to the need to not only teach technology skills to teachers, but also to convince teachers of the value of engaging students in problem based and project based learning with the new tool of technology (as cited in McKenzie, 2001). The constructivist approach to teaching is the ideal approach to use when integrating technology. Constructivist environments engage learners in the construction of knowledge and collaborative activities that put learning in a meaningful context. Constructivism allows for reflection on what has been learned through conversation and interaction with other students and facilitates computer based learning environments (Semple, 2000). Constructivism is certainly not new to education, but with a renewed call for problem solving, higher order thinking, relevance in the classroom, and the search for ways to use technology to impact student achievement, constructivism seems to have made a resurgence. Of particular interest is the relationship between technology and constructivist teaching practices.

While Jean Piaget is generally credited with the organization of the ideas of constructivism, similar thoughts and ideas can be found in the work of John Dewey, Immanual Kant, Socrates, Aristotle, Vygotsky, and John Locke (Crowther, 1997; Rakes, Fields, & Cox, 2006). There are certainly many researchers since Piaget who have attempted to define or capture the idea of constructivism in their writings. It is important to look at some of the definitions of constructivism to better understand the potential relationship between constructivism and the use of technology. Listed below are several definitions of constructivism:

1. Constructivism allows educators to use open-ended and active learning in the classrooms. It causes learners to be challenged and to seek further knowledge. Learners are able to take new knowledge, apply it to prior knowledge, and construct their own knowledge (Hanley, 1994).
2. Constructivism is a manner of teaching that calls for knowledge to be constructed and grow through experience. The four elements considered essential

to constructivism are: activating knowledge, acquiring knowledge, understanding knowledge, and reflecting on knowledge (Zahorik, 1995).

3. Constructivism can be summarized into three primary components: understanding is found in our interactions with the environment; conflict or questions are the stimulus for learning; and knowledge develops through social interactions and their relations with individual understanding (Savery & Duffy 1995).

4. Constructivism emphasizes teaching for understanding, student autonomy and self-direction, and frequent interaction and engagement among students and teachers (Solomon et al., 1996).

5. Constructivism includes the following components: knowledge is constructed from experiences of the learner; knowledge resides in the mind rather than externally; learning is a personal interpretation of the world that the learner's beliefs and values are used in interpreting objects and events; learning is an active process of making meaning from experience; learning takes place in contexts relevant to the learner; reflection is an integral part of learning; and learning is a shared process in which multiple points of view are considered (Greening, 1998, as cited in Royer, 2002).

Furthermore, based on extensive research, Grabe and Grabe (1996) developed a comparison between traditional (teacher centered) teaching and constructivist (student centered) teaching. In Table 1, Grabe and Grabe reduced the idea of constructivist

Table 1

Teacher Centered versus Learner Centered Teaching

Classroom focus	Teacher Centered (Traditional)	Learner Centered (Constructivist)
Teacher role	• Present information • Manage classroom	• Guide discovery • Model active learning • Collaborator (sometimes learner)
Student role	• Store information	• Create knowledge • Collaborator (sometimes expert)
Curricular characteristics	• Breadth • Fact retention • Fragmented knowledge and disciplinary separation	• Depth • Application of knowledge • Integrated multidisciplinary themes
Classroom social organization	• Independent learning • Individual responsibility for entire task	• Collaborative learning • Social distribution of thinking
Assessment practices	• Fact retention • Product oriented • Traditional tests • Norm referenced	• Applied knowledge • Process oriented • Alternative measures • Criterion referenced
Role for technology	• Drill and practice • Direct instruction • Programming	• Exploration and knowledge construction • Communication (collaboration, information access, expression)
Technology content	• Basic computer literacy with higher-level skills building on lower-level skills	• Emphasis on thinking skills and application

Note. Adapted from “Integrating technology for meaningful learning”, by M. Grabe & C. Grabe, 1996, Boston: Houghton Mifflin.

teaching to the following components: role of the teacher; role of the student; curriculum; classroom organization; assessment practices; and the role of technology in the classroom.

One of the greatest challenges for professional development and technology integration is to move the teacher from a lecturer to a facilitator (Harasim et al., 1995, as cited in Creaton & Littlejohn, 2000). The teacher must assume the role of a coach or facilitator by helping students access information, process it, and communicate their understandings (Dexter et al., 1999). To effectively incorporate technology, teachers must redesign their lessons around technology resources, solve logistical problems of how to teach a class of students with a small number of computers, and adjust the role of the teacher for the classroom transformed by technology (Maddox, 1997, as cited in Franklin et al., 2001).

In the National Plan for Improving Staff Development published by the National Staff Development Council, Sparks and Hirsh (2001) suggest effective staff development must result in teachers being “deeply immersed” in subject matter and teaching methods. It must also be curriculum centered and standards based. Teachers must be provided with pedagogical support through observation of technology-enhanced lessons, curriculums and classrooms as well as be provided consultation opportunities with mentors experienced in the integration of technology (Brunner, 1992, as cited in Franklin et al., 2001). Teachers who are versed in various learning theories and have a thorough knowledge of his or her students along with a high level of competence in using and applying a range of educational technologies will create appropriate learning environments that are sure to result in an improvement in student achievement (Semple, 2000). For this reason, it is critical that instructional practices and the relationship to technology be a primary target of actions designed to allow technology to truly impact student achievement (Niederhauser & Lindstrom, 2006).

With a solid understanding of constructivism, the next logical step is to look more closely at the relationship between constructivist teaching and technology. The way a teacher uses computers is generally considered to be related to their philosophy of teaching. In Becker's research, he determined that there is a strong relationship between teachers' philosophical beliefs and what constitutes good teaching, especially with regards to the use of computers.

Teachers who held traditional didactic philosophies used computers as remediation and reinforcement tools. Drill and practice and games were commonly used to have students practice and master basic skills. Teachers with more constructivist views were more likely to use computers to foster their ability to communicate electronically with other people, present information to an audience, and work collaboratively with others (Becker 2000).

Honey and Moeller's (1999) research, around the same time period as Becker's, found a similar relationship between teachers' pedagogical approach and their integration of technology. The more constructivist teachers were more likely to use technology in the classroom as opposed to teachers with the more traditional approach. The more traditional teachers were less likely to integrate technology and more likely to be found lecturing from textbook material. Vannatta (2004), Hermans et al. (2008), and Teo, Chai, Hung, and Lee (2008) are just a few of the many more researchers that have also found that constructivist teachers are more likely to use technology and to use it as a tool to advance learning associated with the ideas of constructivism.

In a study of 1404 middle and high school teachers in 54 schools in 22 separate school districts in Massachusetts, researchers found that teachers' beliefs on pedagogy and the impact of technology were positively related to the amount of time students used computers under the teacher's direction, the use of technology by the teacher to deliver instruction, and the use of technology by students to create products of learning (O'Dwyer, Russell, & Bebell, 2005).

In 1997, even the White House weighed in on technology and constructivism. The President's Panel on Educational Technology noted that constructivist teachers place a large amount of control with the student as their students complete authentic tasks in a realistic context that requires students to use varying sources of information and knowledge. The Panel was unwilling to make a definitive statement regarding the preference of a constructivist approach, however they did state their belief that the essential elements of such an approach (constructivism) are likely to be an integral part of improving the quality of education in both elementary and secondary schools. They further stated that is likely that constructivism may ultimately provide the type of classroom environment most conducive to the application of technology (President's Committee of Advisors on Science and Technology, Panel on Educational Technology, 1997).

Considering the research available on the benefits of technology on student achievement and the potential relationship of constructivist practices to the integration of technology in the classroom, there is certainly a need to further consider the effects of teachers' pedagogical beliefs or their beliefs about instructional practices on both the current and future levels of technology integration in the classroom.

Technology and Professional Development

"Teachers value increased student achievement as an outcome of professional development more than any other variable and judge the value of their professional development activities by how much they see a leap in student outcomes," notes Lockwood (1999). Professional development has been found to be most effective when it is based on student learning goals that reflect the needs of the particular school whose staff is participating in the professional development. These needs may be based on the needs of teachers and of the district, but most importantly, they must be based on learning outcomes and the needs of students (Reitzug, 2002; Chamberlin & Scot, 2002). Joyce, Wolf and Calhoun (1993) note that they did not find a single case in their review of literature on professional development and school initiatives "where student learning increased but had not been a central goal" (as cited in Reitzug, 2002, p. 8).

Greenwald, Hedges, and Laine (1996) found that there is a greater increase in student achievement for money spent on professional development than for money spent on increasing teacher salaries or reducing class size. The content and methods advocated in professional development in combination with the quality of professional development can influence student achievement. In a three year study of technology and achievement by Mann and Shafer (1997), it was determined that "in schools that had more instructional technology and teacher training…we found a strong relationship between increased technology and higher scores…" (as cited in Mathews, 2000, p. 386). As a result of this professional development, Fulton (1998) pointed out that teachers must be technology savvy if we expect our students to graduate having developed workplace skills (as cited in Wright, Rice, & Hildreth, 2001). Despite the money expended on professional development, improvement in academic achievement by using technology has been poor in many of our nation's schools over the past decade (Mathews, 2000). Clark (1994) claims there is no compelling evidence in the past 70 years of published and non-published research that technology causes learning under any circumstances.

Internationally, education researchers have expressed a high expectation for the use of computer technology to improve teaching and learning (Gentile, Clements and Battista, 1994, & Kapul & Roschelle, 1997, as cited in Norton et al., 2000). Harold Weglinsky (1998), an associate research scientist at Educational Testing Services reported that technology can have positive benefits on student achievement depending on how the technology is used.

If technology is to produce the expected improvements in student achievement, teachers must see the direct link between technology and the curriculum (Jayroe, Ball, & Novinski, 2001). Sparks & Hirsh (2000), note that "a growing body of research shows that improving teacher knowledge and teaching skills is essential to raising student performance" (p. 5). Opportunities for teachers to develop their own computer skills correspond with enhanced student achievement (Donlevy, 1999; Mann, Shakeshaft, Becker, & Kottkamp).

In a study of 900 school districts, Ferguson (1991) found that teacher expertise accounted for 40% of the difference in student achievement in reading and math. Another study found that teacher qualification accounted for more than 90% of the variance in student achievement in a large urban district (Armour, 1989, as cited in

Reitzug, 2002). An eight year, seven million dollar investment in West Virginia's elementary schools determined that 11% of the total increase in the basic skills achieved by fifth grade students was a result of the investment in technology. Sivin-Kachala's (1998) review of literature found that the use of computer technology led to improved student achievement by students in every content area, including special education. Kulik's studies (1994) showed that the use of a certain computer based instruction program raised achievement at least 1.4 years in 10 months of use. Weglinsky (1998) found that higher order uses of computers led to increased student achievement in math for both fourth and eighth graders. Problem based learning or project-based learning supported by educational technology has been shown to improve scores as much as 10% on statewide assessments for reading, writing, and math (Stites, 1999, as cited in Guhlin, 2001).

"Traditionally, the culture of professional development of teachers has revolved around one shot hits or spot training (whether one day or multi-day institutes) which are not sufficient to contextualize and consolidate the kinds of change in practice and challenges to practice that need to occur on a regular basis for teachers" (Gross, Truesdale, & Bielec, 2001, p. 164). Currently, professional development occurs in one shot trainings ranging from mini-workshops to three or four day conferences and it is limited (Reitzug, 2002). This type of professional development has been unsuccessful in helping teachers achieve technology integration (Jayroe et al., 2001). Hurst (1994) learned through thousands of conversations with principals and teachers that educators have had positive experiences with professional development, but they have found it to be too short and too infrequent.

The literature on teacher change has pointed out that change will not be implemented and sustained if traditional top-down models of information dissemination and one shot workshops continue (Guskey, 1996, Richardson, 1990, Sarason, 1993, & Soloway et al., 1996 as cited in Gross et al., 2001). The complexity of teaching is not compatible with such models. An effective professional development program is an ongoing process (Rodriguez & Knuth, 2000). A study of the Eiffel project in 2000, which involved a twelve week ongoing workshop to help teachers integrate technology, found that it would be unrealistic to expect teachers to integrate computers into their classroom in a short period of time (Mouza, 2002/2003). Truly integrating technology into teaching is a slow and time-consuming process that requires a great deal of ongoing support and follow-up. Becker (1991) suggests this type of change may take two to three years (as cited in Wetzel, 2001/2002). Others suggest this type of change may take three to five years in a school well equipped with technology and even longer in a school that is poorly equipped (Rodriguez & Knuth, 2000). Speck (1996) suggests that “substantial change in school practice typically takes four to seven years, and in some cases longer.” Unfortunately, research performed by Becker (1991) found that only 5% of technology implementation programs exceed beyond a three to five year period in schools (Becker, 1991, as cited in Wetzel, 2001).

Teachers need long term professional development and training to successfully integrate technology (Hancock, 1993, & Levinson and Doyle, 1993, as cited in Hope, 1997). Professional development in technology needs to be ongoing and supported by a long-term plan developed by all those who participate (Belanca, 1995, Bradley, 1996, & US Dept of Education, 1996, as cited in Royer, 2002). Sparks and Hirsh (2000) noted that professional development should be sustained, rigorous, and cumulative. Research by Sheingold and Hadley (1993) suggests that teachers' use of technology evolves with experience and time. Joyce, Wolfe, and Calhoun (1993) reviewed several bodies of research and concluded, along with their own experiences, that professional development initiatives require 10 to 15 days of training, about 20 demonstrations of the strategies to be learned, opportunities to practice, and a workplace designed to support the initiatives (as cited in Reitzug, 2002).

Follow up support is an essential component to successful professional development (Clemente, 1991, & Winton, 1996, as cited in Schnackenberg et al., 2001). To maximize the potential of our human resources (i.e. teachers), it is necessary to carry on continuous training (Llorens, Slanova, & Grau, 2002/2003). In addition to sustained professional development, teachers need around the clock access to learning resources to practice newly learned skills (Guhlin, 2001).

According to the literature, a crucial factor to help teachers truly integrate technology is to move away from the traditional form of professional development and move toward professional development that is sustained over long periods of time. Training teachers to perform tasks associated with computer technology is crucial (Barker, 1990, Chopra, 1994, & Wyatt, 1985 as cited in Hope, 1997; Forgasz, 2006). The ultimate goal of technology in education is to provide teachers with the skills and understanding that will enable them to provide a technology rich learning environment for their students (Niederhauser, 2001). As the CEO Forum on Education and Technology (1999) stated, transforming hardware and software into tools for teaching and learning depends heavily on having knowledgeable teachers who are able to use technology in the classroom for the benefit of their students (as cited in Mouza, 2002/2003). Many K-12 educational technology magazines point to the importance of having access, technical support, and training to help teachers integrate technology (Dexter et al., 1999). For effective use of this technology, teachers must be given training, professional development and continued support (Semple, 2000). The effectiveness of technology in schools relies on how well teachers are able to integrate technology into their classroom and the curriculum (MacArthur & Malouf, 1991, & Means & Olson, 1997, as cited in Howard, 2003). The public sentiment continues to call for an increase in training and development for teachers in today's schools. Recent wording in the No Child Left Behind Act specifically addresses the impact of professional development on the integration of technology into curriculum and instruction. It even requires that 25% of technology funding be allocated to research based professional development opportunities (Cradler et al., 2002).

Research has shown that teachers need professional development and ongoing support in order to be able to integrate technology in a meaningful way (Ertmer et al., 1999; Chai & Merry, 2006). In a national survey, almost 2/3 of teachers said that professional development activities caused them to change their teaching (NCES, 1998). Another survey conducted by the Center for Applied Research in Educational Technology asked teachers to rank nine topics and answer 45 questions. After student learning, teachers ranked professional development as it related to the use of technology as the most important topic (Cradler et al., 2002).

Professional development can be thought of as "processes and activities designed to enhance the professional knowledge, skills, and attitudes of educators so that they might in turn, improve the learning of their students" (Guskey, 2000, as cited in Reitzug, 2002, p. 2). Teachers usually agree that there are three major goals of professional development programs which include: changing teachers' beliefs and attitudes, changing teachers' instructional practices, and changing student learning outcomes (Griffin, 1983, as cited in Guskey, 1985).

Lack of professional development in the area of technology can be one of the major obstacles to achieving true technology integration (Sugar, 2002). Most educators participate in a limited amount of professional development. They generally do not go much beyond their district sponsored professional development opportunities and the professional development they do participate in is generally unrelated (Reitzug, 2002). The National Goals Report (1995) stated that only ½ of all teachers had professional development opportunities available to them in technology (as cited in Mathews, 2000). According to Market Data Retrieval (1999), the majority of American teachers receive less than five hours of professional development each year (as cited in McKenzie, 2001). Erik Fatemi (1999) reported that only 29% of teachers he surveyed received more than five hours of technology training in the past year. In a 1998 survey, 31% of teachers said they had received between one and five hours of technology skills training, while 27% of teachers said they received no technology training at all (Trotter, 1999, as cited in Mouza, 2002/2003). In the same survey, only 36% of teachers reported they had received between 1 and 5 hours of technology integration training, while 36% stated they had received no technology integration training at all.

Change will not happen if teacher professional development and the support for the effective use of technology, as it relates to the ability to improve student achievement, continues to be ignored (Lin & Chai, 2008; Semple, 2000). Within the last decade, there has been a tremendous amount of money spent on placing technology within the schools, but training teachers in the proper use of technology has been less of an emphasis (Painter, 2001). School districts typically spend no more than 15% of their technology budget on professional development (OTA, 1995, as cited in Hope, 1997). In 1999-2000, 17% of technology budgets within the schools went to professional development (Denton, Davis, Strader, & Durbin, 2003). It is recommended that as much as 40% of the technology budget be devoted to professional development (Web Based Education Commission, 2000, as cited in Mouza, 2002/2003).

In addition to finding funding for technology related professional development, the type and quality of professional development provided has had an impact on the integration of technology. The workshops that have been the primary source of professional development have not been successful in helping teachers understand how to integrate technology (Royer, 2002). Fullan and Stiegelbauer (1991) noted that “nothing has promised so much and has been so frustratingly wasteful as the thousands of workshops and conferences that led to no significant change in practice when the teachers return to their classrooms” (as cited in Sugar, 2002, p. 12). Many workshops attempt to address specific skills outside the context of the curriculum and the classroom, and therefore have not been useful to teachers in their everyday needs (Gross et al., 2001).

According to Little (1993), training models have been a primary source of professional development opportunities for teachers. This involves outside experts teaching teachers new strategies. While this may help teachers with skill development, it does not give teachers the information necessary for them to use technology to transform their classroom (as cited in Mouza, 2002/2003). Most of the professional development provided to teachers is of a formal nature, and involves the introduction of topics often unrelated to the classroom and rarely is ongoing support part of any professional development (Lieberman, n.d.). Successful training for teachers should make the learning interesting and it should be directly related to the teacher's classroom experience (Lee, 1997).

In a comparison of exemplary computer using teachers with other teachers, Becker (1994) found that professional development support was a major factor in the differences between the teachers. Teachers who have received professional development with computers are more likely to use computers in an effective manner (Archer, 1998, as cited in Flowers & Algozzine, 2000). Teachers who have received training in the past year are more likely to say they are better prepared to integrate technology than those who received no training in the past year (Fatemi, 1999). According to a 1999 survey conducted by the National Center for Education Statistics (NCES), teachers with professional development in the use of computers and the Internet over the past three years are more likely to give student's assignments using computers and the Internet (Rowand, 2000). In that same survey, teachers with more hours of professional development felt better prepared to use computers and the Internet. A review of 176 studies chosen from an original group of 1000 studies, entitled "Report on the Effectiveness of Technology in Schools 95-96," found that teachers are more effective after receiving extensive training in technology integration (West, 1995).

NCES found that teachers who participated in professional development that lasted at least 8 hours were 3 to 5 times more likely to report that the experience significantly improved their teaching than those with less than 8 hours of professional development (Reitzug, 2002). The same survey reported that teachers with more than 32 hours of professional development over the past three years were more likely to report feeling very well prepared than those with less than 32 hours. The same survey reported that 82% of teachers with more than 32 hours of professional development in technology used computers for instruction as compared to only 41% of teachers who had received less than 32 hours.

Helping teachers integrate technology requires a variety of professional development opportunities and support quite different from traditional workshops and training opportunities. Teachers must continue to receive skill training, but they also must receive training in the integration of technology into their classrooms and their lesson plans (Fatemi, 1999; Topper, 2004). One piece of research states that even as little as 45 minutes of professional development can affect true change if it is based on an appropriate needs analysis, content-based instructional strategies, and long term planning. As McKenzie (1999) states, “Too much time has been wasted on teaching computer applications apart from their classroom utilization” (as cited in Chamberlin & Scot, 2002, p. 24).

Professional development has been most effective when it includes both training and support (Reitzug, 2002). Teachers need opportunities for hands-on experience in using and implementing new skills (Chai & merry, 2006). Teachers also need access to technology during their planning time. Ideally, 40-50% of workshops should be spent on guided practice and exploration of technology concepts (Chamberlin & Scot, 2002).

Understanding the importance of professional development, while it is an extremely integral part of successfully implementing technology, may not be enough. When planning for professional development, decision makers must take into consideration any characteristics that may be unique to particular setting or group of teachers. One potential contributor to differences between groups of teacher or schools is the level of poverty within a particular school.

The Challenges of Poverty

Teacher Quality

As suggested by Kati Haycock, director of the Education Trust, the latest research findings prove what parents and educators have always known. The single most important factor that determines the success of students in school, even more than race or poverty, is teacher quality (Haycock, 1998). In a knowledge based society, it stands to reason that students are most likely to achieve under teachers who have a strong foundation in the subjects they are teaching. In a 2002 study of New York teachers, researchers concluded that no matter what study you review or what measures you use, poor students, low performing students, and minority students are more likely to have teachers who are inexperienced, uncertified, and/or poorly educated (Lankford, Loeb & Wyckoff, 2002).

In the United States, students in high poverty schools are more likely to be taught by teachers with three years or less of experience. In California, according to the Public Policy Institute of California, the percentage of teachers with two or less years of experience is twice as high in schools with poverty concentrations greater than 75% when compared to schools with poverty concentrations of less than 25% (Betts, Reuben, &

Danenberg, 2000). In a study of Wisconsin schools, researchers discovered that 45% of students in schools with high poverty concentrations were assigned to teachers with five or less years of experience compared to only 22% of the students in schools with low poverty concentrations.

In addition to the lack of teacher experience in high poverty schools, students in these same schools are more likely to be taught by teachers who lack a major in their field or who lack certification. According to Ingersoll (2004), students attending schools with a 75% poverty concentration rate are more than twice as likely as students attending a school with a 10% or less poverty concentration rate to be taught by teachers not certified in their fields. They are also 1.8 times more likely to be taught by a teacher without a major in their field. Ingersoll discovered that 44% of classes in California's high poverty concentration high schools were taught by a teacher not certified in their area. An alarming 91% of middle school math classes in California's high poverty concentration schools were taught by teachers lacking a major, or even a minor, in math. Across the nation, the proportion of teachers not fully certified is 61% higher in schools with high poverty concentration than in low poverty concentration schools (Bock & Wolfe, 1996).

Also, teachers in schools with high poverty concentrations are more likely to be taught by teachers who have not performed well on standardized measures of assessment. One study found that 34% of new teachers in schools with high poverty concentrations were in the bottom quartile of the SAT compared to only 9% in low poverty schools (Babu & Mendro, 2003). In Illinois, students in schools with high poverty concentrations are five times more likely to be taught by a teacher who failed the state teacher exam at least once and 23 times more likely to be taught by a teacher who failed the exam at least five times (Rossi, Beaupre, & Grossman, 2001).

In addition to issues of teacher quality, the concentration of poverty within schools poses a number of other unique challenges. According to the U.S. Department of Education's 1999-2000 Schools and Staffing Survey (SASS), teachers in high poverty schools versus low poverty schools are more than three times as likely to report that physical conflicts between students are a moderate or serious problem in their schools, more than two times as likely to report that robbery and theft are moderate or serious problems, and more than twice as likely to report that vandalism is a moderate or serious problem (Park, 2003) According to the 2003 Quality Counts survey, teachers from schools with high poverty concentrations were more likely to report that student disrespect and lack of parental involvement were problems (Education Week, 2003). Teachers who work with students from poorer families are more likely to feel that their students bring behaviors into the classroom that make teaching difficult and may even feel that they have little influence over student learning (Benard, 1996). This could contribute to a teacher's sense of efficacy.

Solomon et al. (1996), in a study of 476 teachers in 24 urban and suburban elementary schools, found that teacher in schools with high poverty concentrations tended to be less optimistic about student learning potential, less trusting of students, saw their environment as less supportive and stimulating, and felt less positive about their working conditions. These teachers also felt less satisfied with their jobs, less warm and supportive, and even more irritable.

This same study by Solomon et al. (1996) also addressed a critical component of technology implementation which is the instructional practices of teacher. In their study, they found that students in schools with high poverty concentrations were subject to more extrinsic control and fewer opportunities for self-direction, participated in fewer class meetings, and were less involved in cooperative learning.

Countless organizations have called for a new definition of what is considered important in classrooms, contending that a student's experiences should not be focused on memorizing basic facts, skills, and procedures. The argument is that school should involve understanding of central concepts and new ways of knowing literature, math, and science. However, this new definition would require significant change in both the content and pedagogy of our classrooms (Spillane & Jennings, 1999). This is especially true in schools with high concentration of poverty where improving test scores is such a tremendous emphasis. Schools with high levels of poverty are often subjected to what has been termed the "Pedagogy of Poverty," which is a classroom with an emphasis on following rules, memorizing and repeating information, repeating drill and practice, and stressing compliance (Haberman,1991). Often, the first reaction to improving low tests scores, which are often associated with schools having high concentrations of poverty, is to sacrifice "quality" teaching for "coverage" of information and repetition of basic skills.

Teachers with high mobility classrooms, which is a characteristic often associated with high poverty, are more likely to review old material than teach new material and they are often less able to adjust instruction to fit the needs of their students (Rothstein, 2004). In a 1993 comprehensive study of Chapter I (Title I) services entitled Prospects: The Congressionally Mandated Study of Educational Opportunity and Growth, researchers determined the following: teachers of math and reading reported that computers were almost never used in their regular classrooms; instruction for disadvantaged students often stressed basic skills such as knowing facts and details and not higher order skills such as synthesizing data; disadvantaged students spent significant time on the memorization of facts and working on low-level disconnected instructional trivia while advantaged students worked on problem solving; and finally, teachers in high poverty schools were much more likely to rely on textbooks while low poverty schools used trade books and other literature (Puma, Jones, Rock, & Fernandez, 1993). These methods stand in stark contrast to the instructional practices discussed in the proceeding section that are believed to be most conducive to technology implementation.

Technology

Along with the above information regarding the instructional practices of teachers, it is important to look at further discrepancies as they relate directly to technology. In his research, Becker (2000b) determined that the available technology in schools with a high concentration of low-income students is generally one or two years behind schools with mostly middle-class students and three to four years behind schools with high concentrations of students from high income families. Research shows statistically significant differences between high and low socioeconomic status school in terms of student access to software, teacher use of software, and level of technical support (Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008). A report conducted by the Office of Educational Research and Improvement (OERI) in 2000 found that schools with less than 11% of its students qualifying for free or reduced lunches had a 7 to 1 student to computer teacher ratio. In schools with more than 71% of its students qualifying for free or reduced lunches, the student to computer ratio was a significantly worse 16 to 1 (U.S. Department of Education OERI, 2000a). Swanson (2006) reported that the average level of computer access for all schools has remained relatively the same with a 4 to 1 ration of students to "instructional' computers. Rodriguez and Knuth (2000) contend that meaningful change in the area of technology may take three to five years, but even longer in schools such as these, that are poorly equipped.

Besides the lack in technology resources, Becker (2000b) also found that teachers working in low socio-economic status schools reported using the computer with their students more frequently than any other socioeconomic group. According to the "Teacher Use of Computers and Internet in Public Schools" (OERI, 2000b) and "Does it Compute?" (Weglinksy 1998), students in Title I programs and minority groups reported more frequent use of computers than those not receiving special services.

In a longitudinal study of kindergarten and first graders entitled The Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999, researchers studied a subsample of 9,840 children in 669 public schools. They discovered that schools with more than 50% of their students in poverty used computers more for instructional purposes during kindergarten and significantly more for read/write/spell programs in first grade than did schools with less than 50% of their students in poverty (Judge, Puckett, Cabuk, 2004).

Unfortunately, even though there are several reports of students in disadvantaged schools using computers more frequently, it has not lead to improved student achievement (Wainer, Dwyer, Cutra, Covie, Magalhaes, Ferreiro, Pimenta, & Claudio, 2008). Teachers in high poverty schools were less likely to assign student work involving computer applications, research using CD roms, and research using the Internet than their peers in low poverty schools (DeWitt, 2007; OERI, 2000b). Students in schools with more than 71% of its students qualifying for free or reduced lunches used computers for drill and practice 35% of the time compared to 21% of the time students in schools with less than 11% of its students qualifying for free or reduced lunches used computers for drill and practice. This discrepancy in the use of technology in high versus low poverty schools is at the heart of this current study as this researcher attempts to determine the effects of the concentration of poverty on the level of technology implementation by teachers, teachers' current instructional practices, and teachers' sense of efficacy.

The importance of this issue is provided further validity by a study conducted by Michael Page of Louisiana Tech University of 211 students in five Louisiana elementary schools from low socioeconomic backgrounds. Page (2002) found that technology enriched classrooms were conducive to higher levels of math achievement, higher levels of self-esteem, and more student-centered environments among students of low socioeconomic status. He further concluded that children in technology enriched classrooms appear to score higher on standardized math tests, work well in cooperative groups, and are more likely to take control of their learning environment. If it can happen in five elementary schools, why can't it happen in all schools?

In addition to problems associated with technology use throughout all public schools, a more serious and immediate crisis exists in schools with high concentrations of poverty. A 1995 study by the Markle Foundation revealed that the "same divergence found in society along cultural and racial lines is found online and off-line" (Stoicheva, 2000, P. 1). The former president of the Markle foundation, Lloyd Morrisett, called this a digital divide between the technology haves and have-nots. Cavin (2000) called the Digital Divide the Civil Rights issues of the new millennium. A 1992 study by Becker noted that U.S. schools in poor districts or schools with a majority-black student enrollment had 10% to 12% fewer computers than other schools. A study compiled by the National Center for Education Statistics indicated that the level of Internet access is significantly lower for the poorest schools in comparison with other schools. A 1995 study by NCES noted that schools with high concentrations of poverty place computers in the classroom only 38% of the time (Yau, 1999).

Urban households with incomes of $75,000 or higher are over 20 times more likely to have access to the Internet that rural households at the lowest income levels, and they are more than nine times more likely to have a computer at home (Lonergan, 2000). Poverty was found to have the strongest effect on computer access. Only 31% of students from families earning less than $20,000 use computers at home, compared to 89% of those from families earning more than $75,000 (Internet, 2002). The poorest schools had 16 students per computer with Internet access compared to seven students per computer for schools with the lowest concentrations of poverty (Lonergan, 2000). As of the fall of 1998, 39% of classrooms in poor schools were connected to the Internet, compared to 74% in wealthier schools. Also, only 50% of the schools with the highest concentration of poverty were connecting to the Internet using dedicated lines in 1998. 77% of schools with the lowest concentrations of poverty had dedicated lines (Lonergan, 2000). Data collected from Advanced Telecommunications in U.S. Public Elementary and Secondary Schools, a 1995 survey, indicated that the higher the socio-economic status of the student body, the more likely the school will have higher levels and faster types of Internet access. Student of low socio-economic status are likely to have lower levels and slower types of Internet access (Leigh, 1999). The percentage of classrooms with Internet access in high poverty public schools did not increase between 1998 & 1999, while the percentage of connected classrooms in schools with lower concentrations of poverty did increase (Lonergan, 2000).

Additionally, schools with a high proportion of students from low-income families are less likely to have the resources necessary to support the optimal use of technology. Older buildings often have inadequate wiring and phone lines. Technical support, curricular materials and professional development are more likely to be inadequate in poor districts (Education Commission of the States, 1998). Noguera states that underprivileged urban and inner-city students who need the most help are being stuck with the oldest buildings, the worst teachers, and the lowest academic expectations. These same urban and inner city students to which Noguera refers are often the same students situated in schools with high concentrations of poverty (as cited in Harrell, 2001). In a 2000 study of Washington Schools, an enormous disparity was found in the amount of spending directed toward technology. The top ten percent of schools in Washington spent an average of $357 per student while the bottom 10 percent spent only $22 per student. The schools in the middle 20 percent spent $93 per student (Schubert, 2000).

Schools

Of the nearly 12 million U.S. children under age 18, nearly 1/3 live in extreme poverty with incomes below 50% of the poverty line (U.S. Bureau of the Census, 2001).

Data from a 1999 census revealed that 19% of children under 18 were growing up in a family with an income below $16,400 (Forum on Child and Family Statistics, 1999). Poverty in general is associated with significant health risks such as poor nutrition, low birth weight, and exposure to alcohol and drugs. In fact, more than 40 years of research backs these findings. Children of poverty are also less likely to receive quality healthcare or child care (Thompson, 2002).

As a result of these conditions, children of low socioeconomic status (SES) are more likely to drop out of school and not graduate (LaVeist & McDonald, 2002). One study estimated the loss of lifetime income as a result of dropping out of school ranges from $20,000 to $200,000 per dropout. Looking at the number of dropouts in the United States from the graduating class of 1981, it is estimated that more than 238 billion dollars has been lost in earnings, resulting in lost taxes of more than 68 billion dollars. This same study estimated that increasing spending to address the achievement gap of students in poverty could result in an investment that may actually earn $4.75 for every dollar spent. Another important consideration is that 80% of the current prison population dropped out of school (Whaley & Smyer, 1998).

According to a report prepared by the Washington Education Association Council, low family income and the negative effects of poverty have significant effects on how well students do in school. As early as 1966, Coleman reported that SES is a strong predictor of student achievement (Coleman, 1966). Linda Darling-Hammond (1999) studied 2 years of NAEP data at the state level for 4th and 8th grade math and 4th grade reading and found that poverty was significantly and negatively correlated with student outcomes at the state level. The Louisiana Department of education analyzed student data from 1997-2001 in grades K-12 and found that students on free and reduced lunch, which is an indicator of low SES, were twice as likely to be retained in school than students who were not on free and reduced lunch (Louisiana Department of Education, 1999-2000). Chall (1996) analyzed NAEP data, scholastic aptitude tests, and reading levels from 1910 to 1966 and found large differences in the achievement of low and high SES students. He pointed out that the differences increase in the higher grades. A study of 6,000 4th grade classrooms in Texas showed that classrooms with high concentrations of poverty had significantly lower gains on norm referenced tests (Lopez, 1995). And in one case, there is even a term for the results of the achievement gap as it relates to SES. The "Volvo Effect" is a term used to describe why students from a high SES are more likely to achieve a high score on the SAT than students from a low SES (Sacks, 1999).

While individual poverty is certainly a major factor in dealing with the achievement gap of poor students, the concentrations levels of poverty within a school is another significant factor. All student poverty is not equal in terms of effects on achievement. Students who attend schools with high levels of poverty are more likely to have achievement difficulties than students who attend schools with low concentrations of poverty (Orland, 1990). The concentration of poverty within a school has been shown to be harmful to all students in that school, even those who don't come from low SES situations (Kober, 2001). School poverty concentration is related to lower performance on every education outcome. In one study, student performance on achievement tests in both 8th and 10th grade decreased as the percentage of poor students increased (Lippman, Burns, & McArthur, 1996). Also, students in high poverty schools were more likely to take vocational education courses, less likely to take advanced courses, had less access to gifted and talented programs, had poorer quality resources, and were less likely to spend as much time on homework or feel as safe as those students in schools with a lower poverty concentration (Lippman et al.).

Students in schools with a concentration of poverty as low as 25% have been shown to perform poorer academically than students in schools with lower percentages of poverty (The College Board, 1999). In a study of urban schools belonging to the Council of Great City Schools, the results of standardized achievement tests indicated that the higher the concentration of poverty in a school district, the lower the student achievement (Council of the Great City Schools, 2001). The A+ Commission in Washington found that schools that met their fourth grade reading goals had a lower percentage of students on free and reduced lunch than those who did not meet their goals. The percentage of schools meeting their goals decreased as the percentage of students qualifying for free and reduced lunches increased (Boeck, 2002). The U.S. Department of Education completed a study of Title I schools in 2001 and found that students who attended schools with the higher concentration of poor students performed worse on both reading and math tests (U.S. Department of Education, 2001). Based on the Iowa Test of Basic Skills and the Washington Assessment of Student Learning, the state of Washington found a clear pattern that the higher the percentage of students qualifying for free and reduced lunch, the lower the overall achievement of the entire student population (Boeck, 2002). The staggering effects of poverty concentration are so well documented that schools in LaCrosse, Wisconsin, San Francisco, California, and Cambridge, North Carolina have begun efforts to integrate school districts based on poverty rather that racial equity (Thomas & Stockton, 2003).

Families

Low income children are more likely to have poor or no dental care, high levels of lead in their blood, asthma, and lack regular medical attention (Rothstein, 2004). Poor children have twice the rate of severe vision impairment as those children who are not poor (Gould & Gould, 2003). And even when the poorer students get prescriptions for lenses based on school assessments, they are less likely to get them or wear them. Children with low birth weights, which are also associated with poverty and the lack of prenatal care, are more likely to fail classes and repeat grade levels (Barton, 2004).

National data indicate that achievement gaps between students attending high poverty schools and those attending lower poverty schools exist beginning in kindergarten (Borman, Brown, & Hewes, 2002). Another report shows that the inequalities of children's cognitive ability are substantial right from the start (Lee & Burkam, 2002). And research shows that students who begin school well behind their peers, and do not receive the necessary attention to catch up, will become frustrated and leave school at the earliest possible stage resulting in a higher rate of dropouts (Thompson, 2002).

Closely associated with children's healthcare and early education is the advantage or disadvantage a student receives as a result of his or her parental influences. Low SES families differ from higher SES families in many ways. They are not as likely to have two biological parents living in the house nor to have adults with college degrees or professional jobs, they are more likely to be from poor neighborhoods, more likely to receive welfare payments, and are more likely to be associated with adults with mental or physical problems. High poverty schools are more likely to have more single parent families with the single parent working, less parents who have completed college, more students that have changed schools more than once (high mobility), less family members who have completed high school, and higher unemployment (NCES, 1996). It has been long recognized that student achievement in school is influenced by the needs of children in their homes and their communities (Donlevy, 2002).

The level of education and types of jobs held by each parent can also have an influence on children. While studying two different homes from different social classes, researchers found that professional parents spoke more than 2000 words per hour to their children while working class parents spoke only about 1300 and poor parents spoke only about 600. As a result, four year old children of professionals have a 50% larger vocabulary than children from working class families and a vocabulary twice as large as the vocabulary of students from poor families. In a similar study, 3 year old children of professionals had a vocabulary as large as that of the poor parents in the study (Hart & Risley, 1995).

Higher SES students are more likely to have received positive social and emotional benefits regarding their learning experiences from their parents. It is believed that parental beliefs and attitudes can have an effect on a child’s reading and literacy ability (Zady & Portes, 2001). In one study of eighth graders whose parents did not have a high school diploma, only 5% of the students achieved in the upper quartile of standardized tests, yet over 50% of the students with at least one parent with a graduate degree scored in the top quartile. Parents with higher education levels, and typically the same parents who raise their children in schools with low concentrations of poverty, are more likely to read to their toddlers, seek expert help in diagnosing learning problems, arrange for tutors, and to push school officials to allow their children to take college prep classes (The College Board, 1999).

Students from low SES situations are also less likely to have their parents involved in school. Yet students whose parents are involved in school are less likely to have behavior problems, more likely to complete secondary school, and more likely to have better academic performance. In one study, only 50% of parents with a household income below $10,000 attended even one school event as compared to 76% of parents with an income more than $50,000 (Child Trends Data Bank, 2003). 75% of teachers in schools with high poverty concentrations reported parental involvement as a moderate or serious problem as compared to only 36% of the teachers in schools with low levels of poverty. “Changing the way parents deal with their children may be the single most important thing we can do to improve children’s cognitive skills” (Jencks & Phillips, 1998).

Another factor to consider in regards to the family is that students in poverty situations are subject to high mobility, or the number of times a child is required to change schools during their school career. According to a 1994 study by the U.S. General Accounting Office, 30% of students with household incomes less than $10,000 changed schools three or more times between first and third grades compared to only 10% of students with household incomes of more than $50,000. Poor students and students from single parent families had the highest mobility rates in a Jefferson County, Kentucky study (Metropolitan Housing Council, 2004). The same study showed that frequent school changers scored lower on school tests (Barton, 2004). Data from a 1991 survey published by the General Accounting Office showed that 41% of frequent school changers were below grade level in reading and 33% were below in math (Metropolitan Housing Council, 2004). Teachers with high mobility classrooms are more likely to review old material rather than introduce new material and are less able to differentiate instruction for all students. A standard curriculum, standard textbooks, and common course requirements could greatly reduce this problem (Viadero, 2000). High mobility, which is closely associated with low SES, has such an effect on student achievement that many states are allowed to exclude the scores of students considered highly mobile from reports required for No Child Left Behind.

Students

What students do with their time when they are not in school is a major concern, especially with students who live in poverty, or attend schools with high concentrations of poverty. Some data suggest that the achievement gap between students of different races and social classes may be largely due to what how they spend their time both in and out of school and the involvement of parents, teachers, and mentors (Clark, 2002). Children in poor families rely mainly on school for academic learning and stimulation, whereas children of middle class families rely on school for only a part of their learning (Boss & Railsback, 2002). High achieving students spend more time engaged in academic lessons in the classroom, more time engaged in structured literacy activities outside of school, and more time involved in structured learning activities both in and out of school (Clark, 2002). With this in mind, it is important to note that students in high poverty schools watch more TV at home, complete less hours of homework, have higher truancy rates, are more likely to feel unsafe, and a have a higher frequency of alcohol use and pregnancy (NCES, 1996). A study by Christakis said that each hour of TV watched per day between the age of 1 and 3 increased by 10% the chance that a child would have attention problems (Christakis, Zimmerman, Digiuseppe, & McCarty, 2004).

Also, large numbers of students have difficulty reading, but the percentage of students who have difficulty reading is higher for low SES students (Lee & Burkam, 2002). Low SES is a reliable indicator of poor reading skills. Children in poverty are less likely to be read to than children from higher SES brackets (Barton, 2004). One study showed that the vocabulary of high SES first graders was double that of low SES students with the correlation between vocabulary and reading success being well documented (Zady & Portes, 2001). Families with higher incomes are more likely to provide cognitively stimulating environments than families with lower incomes and students from this type of environment are more likely to have strong reading skills (Son & Morrison, 2003). Children whose parents read to them have a considerable advantage in language acquisition, literacy development, reading comprehension and overall school success.

School Culture

Leadership

Leadership is a critical part of establishing a structure that promotes the use of technology, and more importantly, promotes training teachers to use technology. Successful technology integration relies on several school based initiatives such as site based management and having staff to provide technical support, (Raack 1997, as cited in Guhlin, 2001; Sandholz & Ringstaff, 1993, as cited in Hope, 1997). Little found that successful schools created support structures that allow for teaming, common space and time to work, and make room assignments and schedules to promote interaction and learning (Little, 1993, as cited in Reitzug, n.d.). To promote such a culture, school leaders need to model the use of technology in their work and constantly encourage the use of technology by teachers (CEO Forum 1999 as cited in Cradler et al., 2002; Weal, 1992, as cited in Hope, 1997). The principal needs to give praise, incentives, and arrange for release time (Naron and Estes, 1985, as cited in Hope, 1997). As a leader of change, the principal needs to create a structure with the ability to reduce or eliminate teachers' fears, and at the same time support teachers' efforts to use computer technology even if they are not yet at an ideal level (Hope, 1997).

If the principal is not a leader in professional development, technology integration will not be successful (Rodriguez & Knuth, 2000). An administrator's attitude toward technology sends a message to the school community about the importance of technology (Norum et al., 1999, as cited in Wright et al., 2001; Wright et al., 2001). A principal must have a clear vision of technology to support student learning, and they must be the promoters and encouragers who see beyond the daily routine and focus on what is possible through the use of technology (Byrom, 1998 as cited in "Critical Issue", n.d.; Guskey, 1998 as cited in "Critical Issue", n.d., as cited in Lockwood, 1999).

In addition to the leadership of the principal, the district should provide school learning experiences and opportunities (McKenzie, 2001). Research has found that a teacher's willingness to participate in an initiative is encouraged by the support of the district level administration (Reitzug, n.d.). Support should come from the local building principal, the district and the school board (Alden, n.d.; Collier, 2001). A review of 176 studies chosen from an original group of 1000 studies entitled "Report on the Effectiveness of Technology in Schools, 95-96" that was conducted by a software company found that support from district level administrators is vital to the successful integration of technology (West, 1995).

Oliver (1997) emphasized the importance of school leaders in having a vision and the creativeness to plan and support thorough and continuous professional development (as cited in “Critical Issue”, n.d.). Even when teachers begin to use technology, leadership will remain an important ingredient in the change process (Levinson and Doyle, 1993, & OTA, 1995, as cited in Hope, 1997).

Teacher Involvement

Teachers play a key role in the successful integration of technology (Kimmel & Deck, 1995, as cited in Parr, 1999). Teachers need to be involved in all decisions about technology from identifying learning objectives and outcomes to where the technology is placed in the building (Brown, Ryba, & Anderson, 1992, as cited in Parr, 1999; Yamagata-Lynch, 2003). Reitzug (n.d.) conducted a literature review and found that decisions about professional development should be made within schools and not at the district level. The most “innovative solutions to practical problems, the best packages of materials, can have no effect on practice if they are not diffused to the level of practitioner” (Guba, 1968, as cited in Hope, 1997, p. 191). The surest way to promote effective technology integration and to get technology to the level of the practitioner is to involve teachers in designing their professional development.

Teachers who are involved as learners and participants experience new knowledge and a wider capability for thought and action (Lieberman, n.d.). Teacher involvement with research will increase the chance that the teachers will use the research for professional growth (Thorson, 1992, as cited in Royer, 2002). Teachers will also be more likely to see the connection between technology and the curriculum (McKenzie, 1999, as cited in Chamberlin & Scot, 2002). They are also more likely to draw from their own teaching experience and knowledge in the classroom to make the connection between technology and learning (Mayer-Smith et al., 1997, as cited in Parr, 1999). Involving teachers is a key to effective technology integration (Anderson, Herr, & Nihlen, 1994, as cited in Royer, 2002; Brown, 1994, as cited in Diaz, Aedo, Torra, Miranda, & Martin, 1998; Dede, 1999, as cited in Wetzel, 2001; OTA, 1995, as cited in Hope, 1997; Reitzug, n.d.; Royer, 2002).

Programs for professional development that are teacher directed rather than administrator directed have proved more effective. They are more in tune with teacher's needs (Alden, n.d.). Cradler and Cradler (1995) found that professional development must be individualized, and teachers must be able to decide on what topics they should learn and when staff development should occur. Teachers should also be given time to plan, learn and implement what they learn (Cradler & Cradler, 1995, as cited in "What can…School leaders can support", n.d.). Finally, if teachers are involved in designing professional development, time is more likely to be spent in a more productive and useful way, especially if teachers are able to create something they can use in their own classroom (Chamberlin & Scot, 2002).

Learning Communities

One of the surest ways to involve teachers, alter their beliefs and attitudes, and practice the principles of adult learning is through the establishment of learning communities. In many schools, teachers are isolated from each other and stuck in what Fullan calls "the daily press" of getting through the schedule (McKenzie, 2001).

Learning inside of the school where large networks of people are struggling with teaching and learning problems is often discounted as a place where learning cannot occur (Lieberman, n.d.). As far back as 1957, the National Society for the Study of Education published the book Inservice Education 56th Year Book. In this book, Henry (1957) proposed that schools and entire staffs should be collaborators in providing inservice education (as cited in Lieberman, n.d.). Nearly 50 years later, this concept is finally taking hold.

A review of 176 studies chosen from an original group of 1000 studies entitled "Report on the Effectiveness of Technology in Schools 95-96" found that "exemplary computer using teachers benefit from a social network of other computer using teachers at their school" (West, 1995, p.1). This same study found that teachers are more successful when they are members of a community of computer using educators, rather than isolated users. Elmore and Burney (1997) state that, "Deep and sustained change requires that people feel a personal commitment to each other" and that instructional improvement not be "a collection of management principles" but rather the development of "a culture based on norms of commitment, mutual care, and concern" (Elmore and Burney, 1997, as cited in Reitzug, n.d., p. 10). Little (1993) argues that the complexity of current reforms require more than simple skill training. It requires a professional growth culture that permits teacher to function as intellectuals rather than technicians (as cited in Heitzug, n.d.). School structures supportive of learning communities will allow for teachers to communicate with each other, share experiences, and work collaboratively to identify and solve problems (Lieberman, n.d.; Reitzug, n.d.; Mouza, 2002/2003). "Learning communities emerging from a nurturing and supportive environment allow members to exchange ideas, share experiences and learn together to accommodate individual learning styles" (Stephens & Evans, 2000, as cited in Chuang et al., 2003).

In a study of two schools, each of which experienced a similarly highly rated professional development program, the difference between the school that effectively implemented the initiative and the school that was unsuccessful in doing so was that the successful school continued to work collaboratively during the implementation process. In the less successful school, teachers worked individually during the implementation process (Heitzug, n.d.). In another study, 52% of teachers who participated in weekly common planning sessions following professional development workshops believed the professional development significantly improved their teaching, while only 13% of the teachers who occasionally participated in collaborative planning reported such changes (Heitzug, n.d.).

Stevens (1999) found that of six professional development strategies, teachers cited collaboration and networking as the most helpful, noting that it permitted them to share their best pratices and benefit from those of others (Stevens, 1999, as cited in Heitzug, n.d.). Teachers need time to discuss technology and other teaching practices with other teachers, and they benefit as a result of time allowed for networking and sharing (Chamberlin & Scot, 2002; Coley, Cradler, & Engel, 1997, Cradler & Engel, 1997, Cradler & Cradler, 1997, & OTA, 1995, as cited in Cradler et al., 2002; David, 1996, & Lockwood, 1999, as cited in "Critical Issue", n.d.; Duffield & Moore, 2006; Lieberman, n.d; Levin & Wadmany, 2008; Lieberman & Miller, 1991, Smylie, 1995, & Steinberg, 1998, as cited in Mouza, 2003/2004; Reitzug, n.d; Steinberg, 1998, as cited in Mouza, 2003/2004). "The frequency, breadth, and depth of collaboration with colleagues influences instructional context and the quality of technology use" (Becker and Riel, 2000, as cited in Cradler et al., 2002, p. 52).

One method to facilitate learning communities is through the development of small groups known as cohorts (Dent, 2000, as cited in Guhlin, 2001; Hresko, 1998, as cited in Diaz et al., 1998; McKenzie, 2001). "Small groups become cohesive and effective due to time spent together, small size, diverse demographics, external threats, and common goals" (McCain, 1996, as cited in Guhlin, 2001, p. 4). The middle school teaming concept is an example of cohort groups. Another method to facilitate learning communities is critical friends groups. Dunne and Honts (1998) reported that participants in critical friends groups cited their participation as the most powerful form of professional development they had ever experienced (Dunne & Honts, 1998, as cited in Reitzug, n.d.). Other methods used to facilitate learning communities include embedded professional development processes using inquiry, discussion, evaluation, consultation, collaboration and problem solving (Reitzug, n.d.). Participation in professional associations and sharing with colleagues within and beyond one's school contribute to increased confidence and motivation for using technology and result in an increase in the use of learner centered teaching strategies (Becker and Riel, 2000, as cited in Cradler et al., 2002).

Learning communities are an essential part of professional development. A review of the literature finds that without interaction among teachers and time to follow up on new learning, change is not likely to occur (Reitzug, n.d.; Wetzel, 2002; Yocan, 1996, as cited in "Critical Issue", n.d.). What teachers like most about inservice workshops and other professional development is the opportunity to share ideas with other teachers (Holly, 1982, as cited in Guskey, 1985). According to Marx et al. (1998), listening to colleagues discuss their difficulties motivates teacher to work through their own difficulties in order to implement new teaching strategies (as cited in Mouza, 2002/2003).

Summary

Throughout the review of literature in this chapter, it has been the intent of this researcher to provide the reader with an overview of the research pertaining to the effective use of technology by teachers in order to impact student achievement in a positive manner. Research has demonstrated that technology can indeed improve student achievement when properly implemented. Proper implementation depends on a large number of factors, but perhaps none are more important than the classroom teacher. And nothing impacts the classroom teacher's effective use of technology more than professional development. Professional development must be designed to address not only technology skills, but also current instructional practices and teacher efficacy, as well as the challenges unique to school level characteristics such as the concentration of poverty within a school.

CHAPTER III

DESIGN

During the past ten years or more, a tremendous investment has been made in the purchase of technology hardware such as computers, software, and digital products. However, a comparable investment has not been made in training teachers to use this technology in a manner that impacts student achievement. Though many factors are likely to influence whether or not technology improves student achievement, there is little doubt that it can make a positive difference when implemented properly.

In order to properly implement technology, policy makers must consider an almost overwhelming array of variables and possible barriers to the successful implementation of technology by teachers. This study is designed to determine through valid and reliable survey instruments and quantitative statistical methods the relationship between the level of technology implementation and teachers' level of current instructional practices, teachers' level of personal computer efficacy, the concentration of poverty within a school, teacher efficacy, and the following demographic variables: gender; age; attainment of an advanced degree; and years of classroom teaching experience.

This study used a survey consisting of 68 questions to collect information from in-service teachers in 15 elementary schools in a southwestern school district. The instrument is based on two previously validated survey instruments. The first instrument used is the Levels of Technology Implementation Questionnaire (LoTiQ) survey developed by Dr. Chris Moersch. This survey in its original form consists of 50 questions designed to provide feedback in three areas. The three areas include Level of

Technology Implementation (LoTi), Personal Computer Use (PCU), and Current Instructional Practices (CIP).

The second instrument used to develop the survey for this study is the Teachers' Sense of Efficacy Scale (also referred to as the Ohio State Teacher Efficacy Scale). This is a survey that has both a long and a short version. For the purpose of this research, the short form was chosen which consists of 12 questions designed to provide an overall score for a teacher's sense of efficacy. It may also be used to provide a subscore in the following three areas: efficacy in student engagement, efficacy in instructional strategies, and efficacy in classroom management. Because the three subcategories are so closely related to teacher efficacy as it is used in this research, only the overall score will be used to answer the research questions of this study. For the purpose of this research, the questions from the Teachers' Sense of Efficacy Scale (TSES) are used in their entirety.

Combining these two instruments, four additional demographic questions designed by the researcher, and two questions designed to assess the overall school culture among teachers as well as the level of support offered by the building principal, a survey was developed consisting of 68 questions. After the survey was designed and the researcher received approval from the Institutional Review Board (IRB), the survey was administered to the designated population.

Population and Sample

All teachers who participated in this study were employed in the same school district. According to Ertmer et al. (1999), it is reasonable to assume that teachers within the same school district face similar first order barriers to technology implementation, therefore differences in the actual level of technology implementation may be an indication of second order barriers. In addition, factors such as stages of computer use and training, computer acquisition, and both instructional and cultural focus may vary significantly between school districts (Blankenship, 1998). This information was a determining factor in the decision to use only one school district in this study. The district in which all survey participants were employed is located in the southwestern portion of the United States. The district is comprised of 15 elementary schools, four middle schools, and two high schools. The district is a large suburban district located in the same town as a major university. The information that follows is designed to "paint a picture" of the district and the schools in which this study was conducted. The community, district and school characteristics presented should be carefully considered prior to any attempt to generalize the results of this survey to another population. The data used to describe the district and schools will be from the 2006-2007 school year, as it is the most recently available through the Office of Accountability. The data used to describe the community will come largely from the 2000 Census data.

Community Level Data

Based on the 2000 Census Data, many of the community level characteristics are displayed in Table 2. It is important to consider not only the school level characteristics, but also the community characteristics during any effort to generalize the results of this research to a greater population. In addition to the data in Table 2, data was available for juvenile offenders. The district had an average of 1 out of every 93.2 students charged with a crime compared to the state's school average of 1 out of every 71.8 students. Also, 87.7% of parents attended at least one parent teacher conference day during the school year compared to the state's school average of 72.2%. Finally, patrons within the community volunteered an average of 4.9 hours per student compared to the state's school average of only 2.5 hours per student.

Table 2

Community Characteristics

Variables	District	State Average
District Population	92, 730	6, 390
Poverty Rate	15%	15%
Unemployment Rate	5%	5%
Avg household Income	$50, 021	$44, 370
Single-Parent Families	27%	29%
Highest Education (25 and older)		
College Degree	47%	26%
H.S Diploma	44%	55%
Less than 12th Grade	9%	19%
Avg Property Value/Student	$47, 348	$34, 815

Note. From "2007 School Report Card", by Office of Accountability, retrieved June 25, 2008, from http://www.School ReportCard.org

District Level Data

This district is one of the largest in the state in which it resides. During the 2006-2007 school year, 13, 317 students were enrolled throughout the district, which represented a 2.4% growth over the previous school year. In comparison, the state average enrollment for a school district was 1,172. Of the more than 13,000 students, 19.6% were classified as gifted and talented while 14.9% were classified as special education. The state's school average for gifted and talented was 12.8% while the state's school average for special education was 15.1%. The student demographics are included in Table 3, which represents a district that has a high concentration of Caucasian students. 30.9% of the district's 1st-3rd grade students received reading remediation as compared to the state's school average of 35.0%. The average number of days absent per student was 9.5 compared to the state's school average of 10.2. Nearly 40% of the district's students met the federal guidelines to qualify for free or reduced lunch compared to the state's school average of 56.0%. The mobility rate for students was 9.9%, meaning that approximately 10% of students at the end of the year were not the same students that were in the district at the beginning of the year. This compares favorably to the state's

Table 3

Ethnic Breakdown

Variables	District	State Average
Caucasian	75%	59%
Black	7%	11%
Asian	3%	2%
Hispanic	6%	9%
Native American	8%	19%

Note. From "2007 School Report Card", by Office of Accountability, retrieved June 25, 2008, from http://www.School ReportCard.org

school average of 10.2%. Finally, 1 out of every 11.7 students received at least one suspension of ten days or less compared to the state's school average of 1 out of every 12.1 students. One out of every 202.1 students received a suspension of more than ten days compared to the state's school average of 1 out of every 111.8 students.

The data in Table 4 present the characteristics of school personnel within the district as well as offering a comparison to the state averages. This table also shows the community average which is based on groupings assigned by the state based on the school's number of students and poverty rate. The community average is designed to provide a benchmark for comparisons to other schools and school districts with similar characteristics.

Table 5 represents the expenditures for the 2006-2007 school year in seven broad categories. The expenditures represent the amount of money spent per student in each category, rather than the total amount of money spent for the district. Data to track

Table 4

School Personnel

Variables	District	Community Avg	State Avg
Regular Classroom Teachers	768.4	916.7	70.0
Students Per Teacher	17.3	18.4	16.7
Regular Classroom Teachers			
Avg Salary (w/Fringe)	$42, 905	$43, 719	$42, 117
Advanced Degree	35.1%	28.6%	26.7%
Yrs of Experience	12.1	12.5	12.7
Number of Spec Educ Teachers	111.6	110.0	8.0
Number of Counselors	40.5	43.7	3.0
Other Certified Staff	61.6	101.8	5.8
School & District Administrators	66.8	69.7	6.3
Avg Salary of Administrators	$72, 819	$74, 229	$70, 032
Teachers per Administrator	13.2	14.7	12.3

Note. From "2007 School Report Card", by Office of Accountability, retrieved June 25, 2008, from http://www.School ReportCard.org

specific technology expenditures would have been relevant for this research, but the data was not available. Tables 6, 7, and 8 are presented in order to give an overall picture of

Table 5

Average Expenditures per Student

Variables	District	Community Avg	State Avg
Instruction	$3, 863	$3, 760	$4, 120
Student Support	$477	$481	$475
Instructional Support	$349	$246	$251
District Administration	$133	$94	$207
School Administration	$366	$385	$399
District Support	$1,001	$1,169	$1,234
Other	$312	$584	$624

Note. From "2007 School Report Card", by Office of Accountability, retrieved June 25, 2008, from http://www.School ReportCard.org

each of the fifteen elementary schools. In addition to giving a picture of each, the information in the charts allow for comparisons and an understanding of the diversity from one school to the next.

Table 6

Ethnic Breakdown by School

School	Caucasian	Black	Asian	Hispanic	Native American
A	67%	5%	3%	18%	7%
B	81%	5%	3%	5%	7%
C	71%	11%	1%	9%	8%
D	67%	10%	3%	10%	10%
E	75%	7%	1%	8%	9%
F	60%	13%	1%	9%	8%
G	76%	2%	1%	3%	18%
H	75%	7%	5%	7%	6%
I	68%	11%	7%	5%	9%
J	80%	3%	7%	4%	7%
K	75%	5%	1%	8%	11%
L	83%	1%	8%	2%	6%
M	76%	4%	7%	8%	5%
N	79%	8%	2%	4%	8%
O	69%	14%	1%	6%	9%

Note. From "2007 School Report Card", by Office of Accountability, retrieved June 25, 2008, from http://www.School ReportCard.org

Table 7

Student Characteristics

School	1st-3rd Graders Receiving Remediation	Poverty Rate	Days Absent/ Student	Mobility Rate
A	42%	64%	11.1	11%
B	23%	25%	8.6	10%
C	28%	53%	10.1	11.1%
D	30%	50%	9.6	9%
E	47%	59%	8.8	20%
F	43%	81%	11.2	35%
G	26%	41%	9.2	7%
H	30%	53%	11.0	11%
I	42%	60%	10.1	11%
J	24%	21%	8.0	4%
K	32%	52%	11.0	18%
L	23%	11%	7.8	6%
M	20%	19%	8.1	7%
N	21%	27%	8.1	8%
O	49%	75%	9.4	19%

Note. From "2007 School Report Card", by Office of Accountability, retrieved June 25, 2008, from http://www.School ReportCard.org

Table 8

Building Characteristics

Schools	Enrollment	Spec Educ Students	Number of Teachers	Yrs of Experience	Advanced Degree
A	506	14.8%	28.7	12.2	43.5%
B	473	17.6%	27.0	16.0	31.6%
C	499	12.2%	29.6	12.2	35.3%
D	444	12.2%	24.2	11.3	31.8%
E	357	15.1%	21.1	9.0	19.0%
F	400	10.5%	24.7	11.2	20.4%
G	236	18.6%	15.6	11.9	19.0%
H	285	22.8%	16.0	12.7	37.6%
I	534	11.6%	30.7	10.5	32.5%
J	317	14.5%	17.6	8.6	36.1%
K	383	20.1%	22.9	14.6	19.9%
L	557	20.1%	28.6	7.6	28.8%
M	722	7.9%	38.7	12.3	34.9%
N	566	10.4%	30.8	9.8	19.7%
O	233	17.6%	14.2	15.9	61.3%

Note. From "2007 School Report Card", by Office of Accountability, retrieved June 25, 2008, from http://www.School ReportCard.org

Procedures

Teachers who participated in this study participated on a strictly voluntary basis and were eligible to withdraw from the study at any time. They were also free to withhold answers from any questions they felt uncomfortable answering. Prior to the start of this study, the University of Oklahoma Institutional Review Board (IRB) granted the researcher permission to conduct research on human subjects. The Informed Consent to Participate in a Research Study form was included in both the original and the follow-up email sent to teachers who were asked to participate. This form included the purpose of the study, the guarantee of confidentiality, and contact information for both the researcher and the researcher's advisor.

Following a meeting with all of the school principals, each principal was encouraged to administer the paper and pencil version of the survey at their next faculty meeting to each of their classroom teachers. Classroom teacher, for the purpose of this study, is defined as any employee who spends at least one-half of their school day as the primary instructor in the classroom. Initially, several of the school principals administered the school survey within their faculty meeting and achieved very high response rates. However, the majority of the principals simply placed the surveys in each teacher’s mailbox resulting in a much lower than anticipated response rate for the overall administration of the survey. Two follow up contacts with each principal and a district wide email improved the overall response rate. The survey was administered during the last nine weeks of school following a snow and ice storm that resulted in teachers and students being out of school for one full week.

All subjects who participated in the study were considered to be at no more risk that what is involved with normal daily routines. Participants were identified only by case number, so as to ensure both confidentiality and anonymity of the participants. The information provided was accessible in anonymous form to the NBEA, the researcher, and the researcher’s advisor. The data was then compiled using SPSS Statistical Software. The results of the study were made available to central office personnel of the southwestern school district, but only in an aggregate format, so as not to identify particular individuals who participated in the study.

Research Questions

1. Is there a relationship between the level of current instructional practices and the level of technology implementation in a Southwestern School District?
2. Is there a relationship between the level of personal computer use and the level of technology implementation in a Southwestern School District?

3. Is there a relationship between concentration of poverty within a school and the level of technology implementation in a Southwestern school district?

4. Is there a relationship between the level of teacher efficacy and the level of technology implementation in a Southwestern school district?

5. Is there a relationship between each of the following demographic characteristics and the level of technology implementation a Southwestern school district:

a. gender

b. age

c. attainment of an advanced degree

d. years of experience

e. school culture

f. principal support?

Instrumentation

The Levels of Technology Implementation (LoTi) framework was developed by Moersch in 1994. The instrument was designed to accurately measure the use of technology in the classroom with a focus on teacher pedagogy not seen in many previously existing instruments. Incorporating the works of the Concerns-Based Adoption Model and Apple's Classrooms of Tomorrow (ACOT) Study, as well as his own experiences, Moersch designed the initial LoTi framework. The LoTi framework is a unique tool to evaluate technology use, in that it focuses on technology integration, instruction, and assessment practices. The framework would be the foundation for the eventual development of the Levels of Technology Implementation Questionnaire

(LoTiQ), which according to Moersch, is now being used in more than 20 states, as well as being used by numerous doctoral students, to determine the impact of various technology initiatives (Moersch, 2001).

The LoTi framework consists of eight stages designed to represent progressive growth through the levels of technology use in the classroom. 80% of the LoTiQ is designed to determine at which level the respondent (teacher) is operating in the classroom. The idea of "levels" of technology implementation is not unique to Moersch's work. In a study of the 2000 National Computers in Education Survey, researchers found that teachers could be classified in descending order based on the frequency of their technology use. The levels suggested included: creating instructional materials; keeping administrative records; communicating with colleagues; gathering information for lesson planning; multimedia presentations; accessing research; communicating with parents; and accessing model lesson plans (Rowand, 2000).

Sandholtz, Ringstaff, and Dwyer (1997) suggested five stages of technology integration. The five levels include: Entry (primarily text based materials and teacher directed activities); Adoption (traditional whole-group instruction and seat work dominate, technology used to teach students how to use technology like word processing), Adaptation (lecture, seat work, and recitation continue to dominate but 30% to 40% of the school day may be enhanced by the use of graphics programs, databases, and computer assisted instruction), Appropriation (teachers understand the usefulness of technology, evidence of project based instruction, and more interactions between students), and finally Invention (teachers experiment with new strategies, knowledge is constructed rather than transferred, interdisciplinary projects).

The eight Levels of Technology Implementation (LoTi) suggested by Moersch and determined by the LoTiQ, along with a general description of each, are included in the following paragraphs, based solely on the information presented by Moersch (1995, p.41). Out of 50 questions on the LoTiQ, 40 are designed to determine the LoTi.

A Level 0, or Nonuse, classification implies there is a perceived lack of access to technology-based tools (e.g. computers) or a lack of time to pursue electronic technology implementation. Existing technology is predominately text-based (e.g. ditto sheets, chalkboard, overhead projector).

A Level 1, or Awareness, classification implies that the use of technology-based tools is either one step removed from the classroom teacher (e.g. integrated learning system labs, special computer-based pull-out programs, computer literacy classes, central word processing labs), used almost exclusively by the classroom teacher for classroom and/or curriculum management tasks (e.g. taking attendance, using grade book programs, accessing email, retrieving lesson plans from a curriculum management system or the Internet) and/or used to embellish or enhance teacher-directed lessons or lectures (e.g. multimedia presentations).

A Level 2, or Exploration, classification implies that technology-based tools supplement the existing instructional programs (e.g. tutorials, educational games, basic skill applications) or complement selected multimedia and/or web-based projects (e.g. Internet-based research papers, informational multimedia presentation) at the knowledge/comprehension level. The electronic technology is employed either as extension activities, enrichment exercises, or technology-based tools and generally reinforces lower cognitive skill development relating to the content under investigation.

A Level 3, or Infusion, classification implies that technology-based tools including databases, spreadsheets, and graphing packages, multimedia and desktop publishing applications, and Internet use complement selected instructional events (e.g. field investigation using spreadsheets/graphs to analyze results from local water quality samples) or multimedia/web-based projects at the analysis, synthesis, and evaluation levels. Though the learning activity may or may not be perceived as authentic by the student, emphasis is, nonetheless, placed on higher levels of cognitive processing and in-depth treatment of the content using a variety of thinking skill strategies (e.g. problem-solving, decision-making, reflective thinking, experimentation, scientific inquiry).

A Level 4a, or Mechanical Integration, classification implies that technology-based tools are integrated in a mechanical manner that provides rich context for students' understanding of the pertinent concepts, themes, and processes. Heavy reliance is placed on prepackaged materials and/or outside resources (e.g. assistance from other colleagues), and/or interventions (e.g. professional development workshops) that aid the teacher in the daily management of their operational curriculum. Technology (e.g. multimedia, telecommunications, databases, spreadsheets, word processing) is perceived as a tool to identify and solve authentic problems relating to an overall theme/concept. Emphasis is placed on student action and on issues resolution that require higher levels of student cognitive processing and in-depth examination of the content.

A Level 4b, or Routine Integration, classification implies that technology-based tools are easily integrated in a routine manner that provides rich context for students' understanding of the pertinent concepts, themes, and processes. At this level, teachers can readily design and implement learning experiences (e.g. units of instruction) that empower students to identify and solve authentic problems relating to an overall theme/concept using the available technology (e.g. multimedia applications, Internet, databases, spreadsheets, word processing) with little or no outside assistance. Emphasis is again placed on student action and on issues resolution that require higher levels of student cognition processing and in-depth examination of the content.

A Level 5, or Expansion, classification implies that technology access is extended beyond the classroom. Classroom teachers actively elicit technology applications and networking from other schools, business enterprises, governmental agencies (e.g. contacting NASA to establish a link to an orbiting space shuttle via internet), research institutions, and universities to expand student experiences directed at problem-solving, issues resolution, and student activism surrounding a major theme/concept. The complexity and sophistication of the technology-based tools used in the learning environment are now commensurate with: the diversity and spontaneity of the teacher's experiential-based approach to teaching and learning; the students' level of complex thinking (e.g. analysis, synthesis, evaluation); and in-depth understanding of the content experienced in the classroom.

Finally, a Level 6, or Refinement, classification implies that technology is perceived as a process, product (e.g. invention, patent, new software design), and/or tool for students to find solutions related to an identified "real-world" problem or issue of significance to them. At this level, there is no longer a division between instruction and technology use in the classroom. Technology provides a medium for information queries, problem-solving, and/or product development. Students have ready access to and a complete understanding of a vast array of technology-based tools to accomplish any particular task at school. The instructional curriculum is entirely learner-based. The content emerges based on the needs of the learner according to his/her interests, needs, and/or aspirations and is supported by unlimited access to the most current computer applications and infrastructure available

Based on the original LoTi Framework, the LoTiQ not only measures the levels of technology implementation, but it also measures the Personal Computer Use (PCU) of the respondent as well as the Current Instructional Practices (CIP). Out of the 50 questions on the LoTi, five are designed to determine the PCU of each participant and five are designed to determine the CIP of each participant. Participants respond to the questions on the LoTiQ based on individual responses to a Likert scale consisting of eight possible responses. The following categories apply to the Likert Scale for this portion of the instrument: a response of 0 indicates the question does not apply to the participant; a response of 1 or 2 indicates the question is “not true of me now”; a response of 3, 4 or 5 indicates the question is “somewhat true of me now”; and a response of 6 or 7 indicates the question is “very true of me now.”

The final component of the LoTi to be discussed is the level of current instructional practices exhibited by teachers. A Level 0 for current instructional practices indicates that one or more questionnaire statements were not applicable to the teacher’s current instructional practices.

A Level 1 for current instructional practices for personal computer use indicates the teacher’s current instructional practices align exclusively with a subject-matter based approach to teaching and learning. Teaching strategies tend to lean toward lectures and/or teacher-led presentations. The use of curriculum materials aligned to specific content standards serves as the focus for student learning. Learning activities tend to be sequential and uniform for all students. Evaluation techniques focus on traditional measures such as essays, quizzes, short-answers, or true-false questions. Student projects tend to be teacher-directed in terms of identifying project outcomes as well as requirements for project completion. The current instructional practices (CIP) portion of the LoTiQ assigns the teacher's current practice, based upon the teacher's responses, to one of eight levels based on constructivist or learner-centered practices in the classroom.

A Level 2 teacher for current instructional practices supports instructional practices consistent with a subject-matter based approach to teaching and learning, but not at the same level of intensity or commitment as Level 1. Teaching strategies tend to lean toward lectures and/or teacher-led presentations. The use of curriculum materials aligned to specific content standards serves as the focus for student learning. Learning activities tend to be sequential and uniform for all students. Evaluation techniques focus on traditional measures such as essays, quizzes, short-answers, or true-false questions. Student projects tend to be teacher-directed in terms of identifying project outcomes as well as requirements for project completion.

A Level 3 teacher for current instructional practices supports instructional practices aligned somewhat with a subject-matter based approach to teaching and learning- an approach characterized by sequential and uniform learning activities for all students, teacher-directed presentations, and/or the use of traditional evaluation techniques. However, the teacher may also support the use of student-directed projects that provide opportunities for students to determine the "look and feel" of a final product based on specific content standards.

A Level 4 teacher for current instructional practices feels comfortable supporting or implementing either a subject-matter or learning-based approach to instruction based on the content being addressed. In a subject-matter based approach, learning activities tend to be sequential, student projects tend to be uniform for all students, the use of lectures and/or teacher-directed presentations are the norm as well as traditional evaluation strategies. In a learner-based approach:, learning activities are based mostly on student questions; the teacher serves more as a facilitator in the classroom; student projects are primarily student-directed; and the use of alternative assessment strategies including performance-based assessments, peer reviews, and students reflections are the norm.

A Level 5 for current instructional practices demonstrates more of a learner-based approach by teachers. The essential content embedded in the standards emerges based on students "need to know" as they attempt to research and solve issues of activities and teaching strategies used in the learning environment are driven by student questions. Both students and teachers are involved in creating assessment instruments (e.g. performance-based, journals, peer reviews, self-reflections) by which student performances will be assessed.

A Level 6 teacher for current instructional practices supports instructional practices consistent with a learner-based approach, but not at the same level of intensity or commitment. The essential content embedded in the standards emerges present students with a challenge as they attempt to research and solve issues of importance to them using critical thinking and problem-solving skills. The types of learning activities and teaching strategies used in the learning environment are diversified and driven by student questions.

A Level 7 teacher for current instructional practices aligns with a learner-based approach to teaching and learning. The essential content embedded in the standards emerges based on students "need to know" as the attempt to research and solve issues of importance to them using critical thinking and problem-solving skills. The types of learning activities and teaching strategies used in the learning environment are driven by student questions. Students, teacher/facilitators, and occasionally parents are all involved in devising appropriate assessment instruments (e.g. performance-based, journals, peer reviews, self-reflections) by which student performance will be assessed.

In addition to the 40 questions for the LoTi and the five questions for current instructional practices, the remaining five questions on the LoTi portion of the survey are designed to assess each teacher's level of personal computer use. A description of each level is provided, as described by Moersch.

A Level 1 teacher for personal computer use shows little skill level with using computers for personal use. Teachers may have a general awareness of various technology-related tools such s word processors, spreadsheets, or the Internet, but generally are not using them.

A Level 2 teacher for personal computer use demonstrates limited skills with using computers for personal use. Teachers may browse the Internet, use email, or use a word processor program, however they are not likely to be confident about troubleshooting simple "technology" problems as they arise. At school, their use of computers may be limited to a grade book or attendance program.

A Level 3 teacher for personal computer use demonstrates moderate skill using computers for personal use. Teachers may begin to become confident users of selected applications such as the Internet, email, or a word processor program. They may also feel comfortable troubleshooting simple technology problems such as rebooting a machine or hitting the "Back" button on an Internet browser, but rely on mostly technology support staff or others to assist them with any troubleshooting issues.

A Level 4 teacher for personal computer use demonstrates moderate to high skills using computers for personal use. Teachers use several common software applications such as multimedia (e.g. Microsoft Powerpoint, HyperStudio), spreadsheets, and simple database applications. They are often confident in their ability to troubleshoot simple hardware, software, and/or peripheral problems without assistance from technology support staff.

A Level 5 teacher for personal computer use demonstrates a high skill level using computers for personal use. The teacher is often able to use the computer to create their own web pages, produce sophisticated multimedia products, and use common productivity applications (e.g. Microsoft Excel, FileMaker Pro), desktop publishing software, and web-based tools. They are also able to troubleshoot most hardware, software, and/or peripheral problems without assistance from technology support staff.

Finally, a Level 6 teacher for personal computer use demonstrates high to extremely high skill level using computers for personal use. Teachers are proficient in the use of most, if not all, multimedia, productivity, desktop publishing, and web-based applications. They typically provide technical assistance to other colleagues and sometimes seek certification for achieving selected technology-related skills.

The LoTiQ has been previously tested for validity, reliability, and internal consistency. A strong correlation was found between the LoTi levels and the actual questionnaire scores in two separate studies in 1997 and 1998. The reliability of the LoTi was determined in 2000 at an overall reliability coefficient level of 0.94. Using Cronbach's alpha, the LoTiQ demonstrated internal consistency on LoTi and Current Instructional Practices ($r=0.7424$ and $r=0.7353$ respectively). Through subsequent factor analysis, it was determined that the LoTi levels are significantly related to Personal Computer Use ($r=0.579$) as well as Current Instructional Practices ($r = 0.422$) (McAdoo, 2005).

To further establish the validity and reliability of the LoTiQ as a quality measurement and research instrument, the LoTiQ underwent an extensive review by Stoltzfus (2005), who determined that both the levels of technology implementation (LoTi) and the current instructional practices (CIP) portions of the survey met the criteria for content validity. She further determined that the current instructional practices (CIP) portion was determined to be statistically reliable and empirically valid. Based on the information developed by Moersch and Stoltzfus, it is only appropriate that the LoTiQ contribute substantially to the current study by this researcher.

The second instrument used for the purpose of this research is the Teachers' Sense of Efficacy Scale (TSES). Megan Tschannen-Moran and Anita Woolfolk Hoy, researchers from Ohio State University, worked closely with eight graduate students to develop what would eventually be known as the Teachers' Sense of Efficacy Scale. It has also been sometimes referred to as the Ohio State Teacher Efficacy Scale, even though the researchers themselves prefer that the instrument be referenced as the Teachers' Sense of Efficacy Scale.

In researching the term teacher efficacy from 1974 to the present and considering previous instruments designed to actually measure teacher efficacy, Tschannen-Moran and Woolfolk Hoy (2001) set out to lead the designing of an instrument that would combine the work of Bandura's instructional efficacy scale, Tom Guskey's writings about efficacy, and previously developed instruments. The other instruments considered included the following: the two instrument item developed by Rand researchers; the 28 item Teacher Locus of Control developed by Rose and Medway; the 30 item Responsibility for Student Achievement item developed by Guskey; Bandura's Instructional Efficacy Scale; and finally, the Webb Scale which was designed by other researchers in an attempt to eliminate the effects of answers influenced by the characteristic of social desirability (Tschannen-Moran, Woolfolk Hoy, and Hoy, 1998).

The instrument developed by Tshannen-Moran and Woolfolk Hoy (2001) was designed to reflect an integrated model of previous research, measures, and definitions of teacher efficacy. Noting that efficacy is specific to a particular task, the TSES was designed to consider not only the task of teaching, but also the particular context of each task. Considering the importance of the various factors that make teaching challenging in comparison to the resources available that might affect the ability to help students learn, Tschannen-Moran and Woolfolk Hoy noted that a teacher evaluates his or her own capabilities such as teaching skills and strategies against their weaknesses in regards to the task at hand and makes a judgment about their own sense of efficacy. The TSES is designed to measure such decisions.

In its original form, the instrument consisted of 52 items. The original 52 items were derived by considering Bandura's instrument, and then supplementing the items on that instrument with additional items that take into consideration the capabilities of teachers. The researchers, alongside the eight graduate students, used a nomination/discussion/revision approach to decide on the final 52 items. Of the 52 items, 23 were taken directly from Bandura's scale. This first instrument was known as the Ohio State Teacher Efficacy Scale (OSTES). It would be refined through three separate studies before begin developed into its current form as the Teachers' Sense of Efficacy Scale (TSES).

During the first study, the 52 item instrument was administered to 224 teachers, all of whom were enrolled in classes at Ohio State University at the time. The teachers were also asked to rate the importance of each item to the task of teaching. All of the items were rated as important, thus none of the items were eliminated because of importance. However, due to the results of principal-axis factoring with varimax rotation, 32 of the original 52 items were retained for further study.

In the second study, the 32 item instrument was administered to 217 teachers, all of whom were enrolled in classes at one of three universities, which included Ohio State University, William and Mary, or Southern Mississippi. Using the results of principal-axis factoring with varimax rotation and a scree test, the 32 item instrument was reduced to 18 items. Within these 18 items, three factors emerged that accounted for 51% of the variance in the teachers' scores. These three factors were labeled efficacy for student engagement, efficacy for instructional strategies, and efficacy for classroom management with reliabilities of 0.82 for student engagement, 0.81 for instructional strategies, and 0.72 for classroom management. Using second-order factor analysis and principal-axis factor analysis to evaluate the responses in both the first and second study, the researchers further concluded that a total score as well as the three subscale scores could be determined to represent a teachers' sense of efficacy.

Finally, construct validity was tested by examining the correlation of the teachers' responses to the OSTES to the teachers' responses on other instruments designed to assess efficacy. The results suggested that the 18 item OSTES was valid and representative of the task of teaching.

In a third and final study, 18 additional items were added to the existing 18 items for a total of 36 items in an effort to address what was perceived as a weakness of the instrument in the area of classroom management. This new instrument was first field tested and then administered to 410 teachers who were students at one of three universities which included Ohio State University, William and Mary, and Cincinnati. Based on the results of principal-axis factoring with varimax rotation and a scree test, the 36 items were reduced to 24 items. Within these 24 items, the reliabilities for the three subscales were 0.87 for student engagement, 0.91 for instructional strategies, and 0.90 for classroom management. Intercorrelations for the three subscales were 0.58 for student engagement, 0.60 for instructional strategies, and 0.70 for classroom management ($p<0.001$). Based on these promising results, further analysis suggested the possibility of an even shorter instrument consisting of 12 items. Intercorrelations between the long and short forms ranged from 0.95 to 0.98.

Both the 24 item instrument and the 12 item instrument were then analyzed using factor analysis and principal axis factoring with varimax rotation. The results suggested that both scales could be used to validly and reliably measure a subscale score in the areas of efficacy in student engagement, efficacy in instructional strategies, and efficacy in classroom management, as well as an overall score to measure teachers' sense of efficacy. Also, by comparing teachers' responses on these two instruments with the teachers' responses on other instruments designed to assess teacher efficacy, construct validity was determined to be both valid and reliable.

The final instrument resulting from the work of the researchers resulted in what is now known as the Teachers' Sense of Efficacy Scale (TSES). Since its development, it has been used in many research studies as a valid and reliable measure of a teachers' sense of efficacy.

The instrument used by this researcher for the current study combines the products of the Dr. Moersch's efforts and the efforts of Tschannen-Moran and Woolfolk Hoy along with four general demographic questions to compose the final survey instrument of 66 items. The 50 questions from the LoTiQ instrument were used in their entirety. The short form of the TSES consisting of 12 questions was used in its entirety. The four demographic questions included in this study are for the purpose of descriptive statistics and were developed by the researcher based on similar questions reviewed in previous research.

Data Analysis

The purpose of this study was to determine if the level of technology implementation by teachers is related to the following: teachers' level of current instructional practices; teachers' level of personal computer use; the concentration of poverty within a school; teacher efficacy; and demographic characteristics including gender, age, attainment of an advanced degree, and years of classroom teaching experience as well as the overall school culture among colleagues and the level of principal support. Using the five research questions and the Statistical Package for the Social Sciences (SPSS) software, the data was described, organized, and analyzed. In an attempt to answer the questions posed in this research, descriptive statistics, regression analysis and correlation were all combined to analyze and report the information gained from this study.

The independent variables for this study include: current instructional practices (CIP); personal computer use (PCU); teacher efficacy (TE); the concentration of poverty (POV); school culture (SC); principal support (PS); and demographic characteristics including gender (GEN), age (AGE), attainment of an advanced degree (ADV), and years of classroom teaching experience (EXP) . The concentration of poverty is determined by the total percentage of students within a particular school that qualify for either free or reduced lunch. The lone dependent variable is the level of technology implementation (LoTi).

Descriptive statistics are procedures used to organize and report data in a form that is easy to understand. Descriptive statistics are most useful in compiling large amounts of data into a usable format. When data in the form of numbers is collected on a survey instrument, there are generally three characteristics of the data that descriptive statistics are deigned to provide. The three characteristics include: the general level or average value of the data (mean, median, and mode), the dispersion or degree which the numbers tend to deviate around the mean (standard deviation), and the distribution shape (Kinnear & Gray, 1999). Descriptive statistics use narrative, graphs, tables, and figures to represent a vivid description of the sample population as well as the results of statistical analysis.

Linear regression analysis is designed to allow the prediction or estimation of one factor based on the knowledge of another by constructing a regression equation (Kinnear & Gray, 1999). Specifically, multiple linear regression analysis may allow researchers to predict the value of a single dependent variable based on the presence of an association between two or more independent variables by constructing a linear equation. This is accomplished by essentially drawing a straight line (regression line) through the scatterplot of points in a manner of best fit. Doing so allows for predictions to be made based on the slope of the line. Using SPSS, this is all done by inserting the values of the variables into the equation established within the computer program. Multiple linear regression was used to determine the relationship between the level of technology implementation (dependent variable) and the independent variables. Once it was determined that a relationship did exist between the dependent variable and the independent variables, a correlation matrix was then used to measure the degree, or strength, of the linear relationship (Kinnear & Gray, 1999).

Summary

Using an instrument comprised of two previously validated survey instruments, four demographic questions, and two additional questions assessing school culture among colleagues and principal support, teachers in 15 elementary school sites were surveyed in a southwestern school district, using a paper and pencil format. The collected data was analyzed using descriptive statistics, regression analysis, analysis of variance, and correlation. Based on the results of the data and the information provided to answer the research questions posed for this study, decision makers should be provided with crucial information to make further decisions about the tremendous expenditures associated with implementing technology into schools. Ultimately, with proper expenditures for technology, student achievement, especially in schools with high rates of poverty, should be positively impacted.

CHAPTER IV

DATA ANALYSIS

Introduction

The purpose of this study was to determine if the level of technology implementation by teachers is related to the following: teachers' level of current instructional practices; teachers' level of personal computer use; the concentration of poverty within a school; a teachers' sense of efficacy; and demographic characteristics including gender, age, attainment of an advanced degree, and years of classroom teaching experience. Ideally, the results of this study will provide school districts with pertinent information regarding second order barriers to technology implementation. While much research has focused on first order barriers such as access to technology, this study focuses primarily on second order barriers which are an essential part of teachers' beliefs about teaching, beliefs about computers, beliefs about classroom practices, and response to change (Ertmer et al., 1999).

Based on the results of this study, decisions regarding money and resources for professional development and training for teachers should be influenced. As the systems of education continue to allocate major resources toward the acquisition of technology in the classroom, it is becoming increasingly important to focus not only on the cost of hardware, but also on the importance of proper professional development for teachers. This study provides school personnel with additional knowledge of the relationship between the level of technology implementation and the characteristics analyzed in this research.

Research Questions

1. Is there a relationship between the level of current instructional practices and the level of technology implementation in a Southwestern School District?
2. Is there a relationship between the level of personal computer use and the level of technology implementation in a Southwestern School District?
3. Is there a relationship between the concentration of poverty within a school and the level of technology implementation in a Southwestern School District?
4. Is there a relationship between the level of teacher efficacy and the level of technology implementation in a Southwestern School District?
5. Is there a relationship between each of the following demographic characteristics and the level of technology implementation in a Southwestern School District:
    a. gender
    b. age
    c. attainment of an advanced degree
    d. years of experience
    e. school culture
    f. principal support?

Sample

The following descriptive statistics are based on a pencil and paper survey administered by the building principal in 15 elementary schools in a Southwestern School District. All building level principals were encouraged to distribute the survey to their teachers during the last six weeks of the school year. While the researcher requested that the surveys be distributed at a faculty meeting of the teachers, the decision was made to leave this decision up to the principals. Most of the principals simply placed the surveys in the mailboxes of each teacher, which likely impacted the overall response rate. The administration of the survey resulted in 146 respondents representing 41% of the total number of 354 elementary teachers employed in the district who spend at least one-half of their work day as the primary instructor in the classroom in an elementary school building within the district, which was the criteria for participation in this study.

The following tables present descriptive information of the study participants. Table 9 presents basic demographic information provided by the respondents. The 146

Table 9

Demographics (N = 146)

Variable	*n*	%
Age Group		
21-30 years of age	36	24.7
31-40 years of age	38	26.0
41-50 years of age	35	24.0
Over 51 years of age	37	25.3
Advanced Degree		
No	86	58.9
Yes	60	41.1
Gender		
Female	139	95.2
Male	7	4.8

respondents ranged in age from the youngest three teachers who were 23 years of age to the oldest teacher who was 65 years of age. The dispersion of the subjects into the four age groups was almost identical. The 41.1% of teachers with advanced degrees is slightly above the overall district percentage of 35.1% and significantly higher than the state average of 26.7 %. Overall, only 9 males completed the survey compared to 139 females. The district percentages are based on not only the elementary teachers, but all of the approximately 768 teachers within the school district which has 15 elementary schools, four middle schools, and two large high schools. In Table 10, the overall mean

Table 10

Experience Demographics (N = 146)

Variable	M	SD
Years of Experience	14.17	9.88
Age	40.73	11.00

of 14.17 years of experience is slightly above the district's reported average of 12.6 years of experience and the state average of 12.7 years of experience.

In addition to the general demographic questions, this study also sought to assess the overall level of technology implementation by each teacher. The overall LOTI score is determined based on the formula developed by Moersch (2002). This score is based on the response to 40 questions designed to assess a teacher's use of technology in the classroom. Five additional questions focus primarily on a teacher's level of personal computer use (PCU), while five more questions focus on a teacher's current instructional practices (CIP) within the classroom. In total, the fifty questions are applied to the formula developed by Moersch to arrive at the LOTI score which is designed to determine a teacher's overall use of technology and implementation within the classroom. Each of the questions asked teachers to respond on a Likert Scale of zero to seven. A response of zero indicates that the question does not apply to the teacher's current situation. A response of seven indicates that the question is very true of the teacher at the time he or she answered. When assessing the overall LOTI, PCU, and CIP scores, note that a higher score (closer to seven), is related positively to the teachers overall level of technology implementation, the teacher's level of proficiency on personal computer use, and the use of constructivist teaching practices. Tables 11, 12 and 13 display the demographic dispersions of the number of teachers at each level on the LOTI Scale. The description of the characteristics of each level can be found in Chapter 2. It is important to note that Moersch identified level 4B as the target level for the implementation of technology by teachers.

Table 11

LOTI (N = 146)

Variable	N	%
0 (Non-Use)	18	12.3
1 (Awareness)	43	29.5
2 (Exploration)	17	11.6
3 (Infusion)	35	24.0
4A (Mechanical Integration)	21	14.4
4B (Routine Integration)	7	4.8
5 (Expansion)	5	3.4
6 (Refinement)	0	0

Table 12

LOTI Demographics (N = 146)

Variable	Male	Female	Adv Degree	No Adv Degree
0 (Non-Use)	1	18	9	19
1 (Awareness)	0	43	14	29
2 (Exploration)	2	15	7	10
3 (Infusion)	1	34	16	19
4A (Mechanical Integration)	2	19	7	14
4B (Routine Integration)	0	7	5	2
5 (Expansion)	1	4	2	3
6 (Refinement)	0	0	0	0

Note. The numbers represent *n* within each category.

Table 13

LOTI by Age Group (N = 146)

Variable	21-30	31-40	41-50	Over 50
0 (Non-Use)	5	3	5	6
1 (Awareness)	12	12	7	11
2 (Exploration)	3	3	8	3
3 (Infusion)	6	9	11	8
4A (Mechanical Integration)	5	7	3	6
4B (Routine Integration)	2	3	1	1
5 (Expansion)	4	1	0	1
6 (Refinement)	0	0	0	0

Data Analysis

A regression analysis was performed to ascertain the effects of the independent variables of current instructional practices, personal computer use, the concentration of poverty, teacher efficacy, gender, age, attainment of an advanced degree, years of experience, school culture, and principal support on the dependent variable, level of technology implementation (LOTI). Table 14 displays the results of the overall model. Based on the adjusted R Square value, the model accounts for 25.8% of the variance in the dependent variable LOTI, which is statistically significant (F= 6.05, $p<.05$).

Correlation was used to determine the strength and direction of the relationship between the dependent variable, LOTI, and the following independent variables: Personal Computer Use (PCU); Current Instructional Practices (CIP); Concentration of Poverty (POV); Teacher Efficacy (TE); Principal Support (PS); School Culture (SC); Age (AGE), and Years of Teaching Experience (EXP). Table 15 provides the details of correlation between each pair of variables. Table 16 provides the Standardized Beta Coefficients which provide a measure of the contribution of each variable to the overall model. The

Table 14

Model Summary

Model	R	R Square	Adjusted R Square	Std Error of Estimate
1	.556[a]	.309	.258	1.370

a. Predictors: (Constant), Advanced, Concentration of Poverty, Teacher Efficacy, Gend, Prin Sup, PCU, Age, CIP, Sch Cul, Exp

ANOVA[b]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	113.375	10	11.337	6.045	.000[a]
Residual	253.208	135	1.876		
Total	366.582	145			

a. Predictors: (Constant), Advanced, Concentration of Poverty, Teacher Efficacy, Gend, Prin Sup, PCU, AGE, CIP, Sch Cul, Exp
b. Dependent Variable: LOTI

variables determined to be significant were personal computer use (PCU) and current instructional practices (CIP).

Results of Research Question One

Is there a relationship between the level of current instructional practices and the level of technology implementation in a Southwestern School District? Table 17 represents the dispersion of the 146 respondents according to their self-reported level of current instructional practices. Each of the questions asked teachers to respond on a Likert Scale of zero to seven. A response of zero indicates that the question did not apply to the teacher's current situation. A response of seven indicates that the question was very true of the teacher at the time he or she answered. When assessing the overall score for current instructional practices, note that a higher score (closer to seven) indicates a more constructivist manner of teaching and classroom procedures.

Table 15

Pearson Correlation Matrix (N = 146)

	LOTI	PCU	CIP	POV	TE	PS	SC	AGE	EXP
LOTI									
Correlation	1	.391**	.477**	-.001	.207*	.132	.113	-.051	-.085
Sig.		.000	.000	.989	.012	.111	.173	.543	.308
PCU									
Correlation	.391**	1	.511**	.004	.169**	-.042	.048	-.230**	-.296**
Sig.	.000		.000	.963	.042	.611	.562	.005	.000
CIP									
Correlation	.477**	.511**	1	-.084	.230**	-.113	-.082	-.174*	-.263**
Sig.	.000	.000		.316	.005	.173	.326	.036	.001
POV									
Correlation	-.001	.004	-.084	1	-.013	.118	.112	.039	-.022
Sig.	.989	.963	.316		.876	.156	.178	.643	.794
TE									
Correlation	.207*	.169*	.230**	-.013	1	.075	-.017	.122	.192*
Sig.	.012	.042	.005	.876		.366	.838	.143	.020
PS									
Correlation	.132	-.042	-.113	.118	.075	1	.677**	.174*	.170*
Sig.	.111	.611	.173	.156	.366		.000	.036	.041
SC									
Correlation	.113	.048	-.082	.112	-.017	.677**	1	.153	.115
Sig.	.173	.562	.326	.178	.838	.000		.065	.168
AGE									
Correlation	-.051	-.230	-.174	.039	.122	.153	.174*	1	.820**
Sig.	.543	.005	.036	.643	.143	.065	.036		.000
EXP									
Correlation	-.085	-.296**	-.263**	-.022	.192*	.170*	.115	.820**	1
Sig.	.308	.000	.001	.794	.020	.041	.168	.000	

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

Table 16

Coefficients[a]

Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
Constant	-2.101	1.268			
PCU	.238	.100	.207	2.375	.019
CIP	.349	.080	.382	4.359	.000
Conc of Pov	.001	.006	.007	.096	.923
Teacher Efficacy	.105	.146	.057	.716	.475
School Culture	.010	.109	.009	.088	.930
Principal Support	.163	.101	.160	1.611	.109
Age	.000	.019	.002	.019	.985
Exp	.001	.022	.004	.032	.974
Gend	.695	.547	.094	1.270	.206
Advanced	.200	.256	.062	.784	.434

a. Dependent Variable: LOTI

Table 17

Current Instructional Practices (N = 146)

Variable	n	%
CIP		
0	8	5.5
1	9	6.2
2	18	12.3
3	25	17.1
4	32	21.9
5	31	21.2
6	19	13.0
7	4	2.7

Note. The mean score for current instructional practices was 3.73 with a standard deviation of 1.74.

The questions from the LOTI questionnaire that were designed to assess each respondent's level of current instructional practices are as follows:

- LOTI Question 6: My students collaborate with me in setting both group and individual academic goals that provided opportunity for them to direct their own learning aligned to the content standards.

- LOTI Question 20: I consistently provide alternative assessment opportunities that encourage students to "showcase" their understanding of the content standards in nontraditional ways.
- LOTI Question 32: Students' use of information and inquiry skills to solve problems of personal relevance guides the types of instructional materials used in and out of my classroom.
- LOTI Question 41: Having students apply what they have learned in my classroom to the world they live in is a cornerstone to my approach to instruction and assessment.
- LOTI Question 50: Students' questions and previous experiences heavily influence the content that I teach as well as how I design learning activities for my students.

The regression analysis (b=.382, p<0.05) confirmed the statistical significance of the relationship. Correlation (r=.477, p<0.05) indicated a statistically significant direct relationship between current instructional practices and LOTI (McMillan, 2008). In other words, teachers who scored higher on the scale for current instructional practices also had a higher level of technology implementation score. Current instructional practices proved to be the strongest predictor of LOTI within this research model.

Results of Research Question Two

Is there a relationship between the level of personal computer use and the level of technology implementation in a Southwestern School District? Table 18 represents the dispersion of the 146 respondents according to their self-reported level of computer use.

Each of the questions asked teachers to respond on a Likert Scale of zero to seven. A response of zero indicates that the question did not apply to the teacher's current

Table 18

Personal Computer Use Levels (N =146)

Variable	*n*	%
PCU		
0	1	.7
1	2	1.4
2	6	4.1
3	13	8.9
4	38	26.0
5	35	24.0
6	40	27.4
7	11	7.5

Note. The mean score for PCU use was 4.77 with a standard deviation of 1.74

situation. A response of seven indicates that the question was very true of the teacher at the time he or she answered. When assessing the overall score for personal computer use, note that a higher score (closer to seven) indicates a more proficient level of personal computer use.

The questions from the LOTI questionnaire that were designed to assess each respondent's level of personal computer use are as follows:

- LOTI Question 13: I am proficient with basic software applications such as word processing tools, internet browsers, spreadsheet programs, and multimedia presentations.
- LOTI Question 15: I can solve most technical problems with our classroom's technology resources during the instructional day without calling for technical assistance.

- LOTI Question 18: I am comfortable training others in using basic software applications, browsing/searching the Internet, and using specialized technologies unique to my grade level or content area.
- LOTI Question 26: I use our technology resources daily to access the Internet, send email, and/or plan classroom activities.
- LOTI Question 49: I regularly use different technology resources for personal or professional communication and planning.

Regression analysis (b=.207, $p<0.05$) confirmed that this relationship is a statistically significant direct relationship. Correlation (r=.391, $p<0.05$) indicated a statistically significant direct relationship existed between the level of personal computer use and LOTI. In other words, teachers who scored higher on the scale for personal computer use also had a higher level of technology implementation score.

Results of Research Question Three

Is there a relationship between the concentration of poverty within a school and the level of technology implementation in a Southwestern School District? The poverty concentration within a school is determined at the elementary level by the percentage of students who qualify for either free or reduced lunches, as determined by the number of students and parents who complete the appropriate standardized form to indicate eligibility for assistance with meal prices. Table 19 represents the poverty concentration of each of the 15 schools in this district as well as the number of respondents from each school. Regression analysis (b=.057, $p>0.05$) and

Table 19

Poverty Concentrations (N = 146)

School	*n*	Poverty Concentration
A	7	71%
B	16	36%
C	28	58%
D	22	56%
E	7	64%
F	9	74%
G	0	41%
H	17	59%
I	0	60%
J	4	23%
K	7	54%
L	3	11%
M	9	18%
N	5	24%
O	10	86%

correlation (r=-.001, p>0.05) indicated no statistically significant relationship between the concentration of poverty within a school and LOTI.

Results of Research Question Four

Is there a relationship between the level of teacher efficacy and the level of technology implementation in a Southwestern School District? The Teacher Efficacy Score is derived from the responses on the 12 questions from the Tschannen and Moran Teacher's Sense of Efficacy Scale. Respondents were asked to respond to 12 questions on a Likert Scale ranging from one to nine. A response of one indicates that the teacher felt like they had no control or influence over a given scenario. A response of nine indicates that the teacher felt he or she had a great deal of control over the given scenario. Each of the twelve questions is designed to assess a teacher's sense of efficacy with his or her students. The survey then takes the mean of the 12 responses for the overall score. The higher the mean, the greater sense of efficacy, as it relates to each respondent's personal belief in his or her ability as a teacher. The mean score of all respondents was 7.58 with a standard deviation of .86, indicating the presence of a strong sense of teacher efficacy within the sample.

Regression analysis (b=.057, p>.05) indicated that there is no statistically significant relationship between teacher efficacy and LOTI. Correlation (r=.207, p<.05) indicated a statistically significant direct relationship between teacher efficacy and LOTI. Further study may be required to further review the inconclusive results for question 4.

Results of Research Question Five

While much of the description of the fifth research question can be found within the section of this chapter describing the sample, two additional research questions found under the umbrella of question five require further explanation. In addition to the general demographic characteristics of gender, age, the attainment of an advanced degree and years of teaching experience, question five also sought to learn more about the culture of each school surveyed as well as the level of principal support in relation to the use of technology.

Regarding school culture, respondents were asked to rate the following question on a scale of 0 to 7, with 0 meaning the question is untrue or not applicable to his or her current school. Question six on the survey designed to gather information on the school culture was written as “My school culture includes a collaborative environment among teachers that supports and encourages the use of technology to improve the teaching and learning process.” A response of seven indicates the statement is very true of his or her current school at this time. Table 20 lists the number of respondents as well as the

Table 20

School Culture (N=146)

Variable	*n*	%
0	0	0
1	4	2.7
2	2	1.4
3	7	4.8
4	22	15.1
5	27	18.5
6	43	29.5
7	41	28.1

percentage of the overall respondents at each level on the 0 to 7 scale. The mean response for this question was 5.46 with a standard deviation of 1.46. Overall, the mean response from this question indicated that the building principals are somewhat supportive of a collaborative school environment to improve the use of technology in the teaching and learning process. 91.2% of teachers indicated they work within a school culture that is somewhat to very supportive of using technology to improve the teaching and learning process.

In regards to principal support, respondents were asked to rate the following question on a scale of 0 to 7, with 0 meaning the question is untrue or not applicable to his or her current school. A response of seven indicates the statement is very true of his or her current school at this time. Question 7 on the survey designed to learn more about the principal support within each school was written as “My building principal(s) provide(s) meaningful support that promotes the use of technology to improve the teaching and learning process.” Table 21 lists the number of respondents as well as the percentage of the overall respondents at each level on the 0 to 7 scale. The mean response for this question was 5.60 with a standard deviation of 1.57. Overall, the survey questions associated with this question indicated that the building principals are

Table 21

Principal Support (N = 146)

Variable	*n*	%
0	0	0
1	3	2.1
2	6	4.1
3	9	6.2
4	11	7.5
5	27	18.5
6	34	23.3
7	56	38.4

somewhat supportive of the use of technology for teaching and learning. 87.7% of teachers indicated they believe their principal is somewhat to very supportive of the meaningful use of technology to improve teaching and learning.

Regression analysis of age ($b = .002$, $p > 0.05$), years of experience ($b = .004$, $p > 0.05$), school culture ($b = .009$, $p > 0.05$), and principal support ($b = .160$, $p > .05$) demonstrated that the LOTI level was not dependent on any of these four variables. Using correlation, age ($r = {}^{-}.051$, $p > 0.05$), years of experience ($r = {}^{-}.085$, $p > 0.05$), school culture ($r = .113$, $p > 0.05$), and principal support ($r = .132$, $p > 0.05$), were all found to have no statistically significant relationship to the level of technology implementation.

An independent samples t-test was used to determine if a statistically significant difference existed between the groups. The results of the t-test are displayed in Table 22. There were no statistically significant differences in the level of technology implementation between male and female teachers. There were also no statistically significant differences in the level of technology implementation between teachers with or without an advanced degree. In other words, the LOTI level cannot be determined by having knowledge of a teacher’s gender or whether or not a teacher has earned an advanced degree.

Table 22

T-Test for Equality of Means

Variable	n	Mean	SD	Std. Error	t	p
Male	7	3.00	1.915	.724	1.252	.213
Female	139	2.23	1.571	.133		
Advanced Degree	60	2.35	1.665	.215	.525	.601
No Advanced Degree	86	2.21	1.542	.166		

Note. Significance is based on p < .05 (2-tailed).

Additional Findings

Additional findings during the data analysis indicated several statistically significant relationships. Correlation (*r* = .230, *p* < .05) indicated a statistically significant and moderately strong relationship between current instructional practices and teacher efficacy. A statistically significant, yet small, relationship was present between a teacher's sense of efficacy and personal computer use (*r* = .169, *p* < .05). Thirdly, a statistically significant and moderately strong negative relationship was found to exist between age and personal computer use (*r* = -.230, *p* < .05) as well as age and current instructional practices (*r* = -.174, *p* < .05). Finally, a statistically significant and moderately strong negative relationship was found to exist between a teacher's years of experience in the classroom and personal computer use (*r* = ¯.296, *p* < .05) and current instructional practices (*r* = ¯.263, *p* < .05).

In addition to the additional quantitative findings, open ended items were also administered to each of the building principals that asked for each principal to report the most current number of teachers on staff as well as the most current level of poverty concentration (students qualifying for free or reduced lunch) within each school. Questions 3, 4, 5, and 6 asked each principal to provide short answers in response to the questions presented. Of the 15 school principals representing each of the 15 schools within the district, 12 returned the survey. The first question asked principals to report on any special promotions or efforts to encourage students and parents to turn in their form to qualify for free or reduced lunches. Because the concentration of poverty is determined by the number of students who actually turn in the form, it is important to know if any type of effort had a significant influence on each school's reported percentage of students qualifying for free or reduced lunch. All 12 principals who responded indicated that they offered no special incentives, programs, or promotions in order to get student and parents to complete the forms. At all schools, the form is included in each student's enrollment packet.

The second question asked principals to comment on any type of extensive technology training (e.g. Intel Teach to the Future) that they, as the building principal, had been involved in. Ten of the 12 principals who responded to the survey had a common experience with technology and leadership training. Through the local university, principals participated in a program consisting of approximately 40 hours of training in not only the use of technology, but also the use of technology in leadership. The program allowed each principal to receive a laptop computer while requiring several regular meetings with a cluster coach. Completion of this training also made each principal eligible to apply for a grant of more than $40,000. Two of the twelve principals had applied for and received the grant for their school. The three reminding principals indicated that they had participated in no type of specialized technology training.

The third question asked principals whether or not their staff had been involved in any type of extensive technology training as an entire faculty (e.g. technology integration training). The two schools that had received the grant had participated in extended technology implementation training as a requirement of the grant. Four school principals reported no specialized or intensive technology training, while the remaining seven principals reported varying degrees of training for smart boards, web page development, and Powerpoint.

The final question asked each principal to identify technology equipment that each and every classroom within the building contained. Each principal reported that all classrooms have 1 to 2 Internet ready computers. Three schools reported having digital projectors in each room. One school reported having access to a digital projector and to two mobile laptop labs with 12 computers each. Overall, very little technology equipment was reported by the 12 principals who responded to the survey.

Summary

Presented within this chapter are the statistical results of this study conducted across fifteen elementary schools involving 146 teachers. By analyzing the data using descriptive statistics, correlation, Analysis of Variance, regression analysis, and an independent samples t-test, the five research questions presented throughout this research were addressed.

A statistically significant relationship was found to exist between the level of technology implementation and the following independent variables: current instructional practices; personal computer use; and a teacher's sense of efficacy. No statistically significant relationships were identified between the level of technology implementation and the following independent variables: poverty concentration within a school; gender; age; the attainment of an advanced degree; years of teaching experience; school culture; and principal support.

Additional findings included the discovery of a statistically significant relationship between the following independent variables; current instructional practices and a teacher’s sense of efficacy; personal computer use and a teacher’s sense of efficacy; personal computer use and age; current instructional practices and age; personal computer use and years of experience; and current instructional practices and years of experience. Though these additional findings were not addressed in the original research questions, the information should be considered significant. The final chapter, Chapter Five, presents the summary, conclusions, and recommendations for further study and analysis of the level of technology implementation by teachers.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Chapter V includes a brief summary of this study, including the purpose and significance, as well as the findings from Chapter IV. Also, the findings of this study in relation to current literature and the possible implications of this research will be addressed. Finally, this chapter concludes with recommendations for practitioners as well as recommendations for further research.

In excess of 8 billion dollars is being spent on technology in schools every year. These expenditures include massive purchases of software, community bond issues, and attempting to replace and update current technology in a manner that allows schools to "keep-up" with the frequent changes in technology. In addition, many schools have the added expenditures of network administrators, technology teachers, trainers, and maintenance. The 2008 Technology Counts, released annually by Education Week, indicates that 96% of students have access to computers within their school while 76% of 8th graders have access. The approximate average number of students is 3.5 students per instructional computer and 3.4 students per computer that is connected to high speed Internet (Bausell, 2008). While the indicator for progress in technology within schools was once the number of computers in the classroom, this can no longer be the benchmark. The new benchmark must be to determine how to make sure the more than 8 billion dollars being spent makes an impact on student achievement. Kleiman (2000) offered the following in response to the criticisms of why these massive expenditures have not realized their full potential in terms of student achievement:

> The central theme underlying all these myths is that while modern technology has great potential to enhance teaching and learning, turning that potential into reality

> on a large scale is a complex, multifaceted task. The key determinant of our success will not be the number of computers purchased or cables installed, but rather how we define educational visions, prepare and support teachers, design curriculum, address issues of equity, and respond to the rapidly changing world. As is always the case in efforts to improve K-12 education, simple, short-term solutions turn out to be illusions; long-term, carefully planned commitments are required (p.20)

The purpose and significance of this study lies in the contributions made to the body of literature involving factors affecting the level of technology implementation by teachers. As a result of this research, practitioners and researchers may further address how to provide meaningful support to teachers and schools in hopes of further realizing the potential of the great technology investment. The Office of Technology Assessment, commissioned by the U.S. Congress, concluded that helping teachers "effectively incorporate technology into the teaching and learning process is one of the most important steps the nation can take to make the most of past and continuing investments in educational technology" (as cited in Parr, 1999, p. 280).

Review

Data from 146 teachers who spent at least one-half of their work day as the primary instructor in the classroom, in an elementary school building within the district, were collected through the administration of a paper and pencil survey within each building. The 146 teachers represented 41% of the 354 teachers that met the criteria for participation in the study across 15 elementary schools. 13 of the 15 schools had at least one teacher complete the survey. The survey asked teachers to complete 68 questions separated into the following subcategories: 50 questions from the LOTI instrument including 40 questions assessing the level of technology implementation, five questions assessing personal computer use by teachers, and five questions assessing current instructional practices of teachers; 12 questions designed assessing each teacher's level of efficacy; four general demographic questions; and two questions designed to assess the level of collaboration and principal support within each school. This purpose of the survey was to answer the five research questions included within this study.

Research Questions

The following five research questions were written to provide the purpose and basis of this study:

1. Is there a relationship between the level of current instructional practices and the level of technology implementation in a Southwestern school district?
2. Is there a relationship between the level of personal computer use and the level of technology implementation in a Southwestern school district?
3. Is there a relationship between the concentration of poverty within a school and the level of technology implementation in a Southwestern school district?
4. Is there a relationship between the level of teacher efficacy and the level of technology implementation in a Southwestern school district?
5. Is there a relationship between each of the following demographic characteristics and the level of technology implementation in a Southwestern school district:
   a. gender
   b. age
   c. attainment of an advanced degree
   d. years of experience
   e. school culture

f. principal support?

Conclusions

Based on the extensive literature review and analysis of the data collected during this study, this section will summarize the findings of this research study. The research findings will also be placed within the context of the current literature whenever appropriate.

Research Question One

Is there is a relationship between the level of current instructional practices and the level of technology implementation in a Southwestern School District? This study concluded that there is a relationship between current instructional practices and the level of technology implementation. In fact, a teacher's score for current instructional practices proved to be the strongest predictor of the level of technology implementation within this study. Teachers who implement more constructivist teaching practices, as determined by the current instructional practices portion of the survey, are more likely to have a higher level of technology implementation score.

Semple (2000) suggested that teachers tend to teach in the way they were taught. For most current teachers, their own classroom experience came well before the widespread use of computers in the classroom. Therefore, many teachers focus on "instruction" which conveys a very directed and controlled approach which is not compatible with the effective implementation of technology. In this study, the mean score for current instructional practices was 3.73. According to Moersch's research, this score suggests that teachers may feel comfortable supporting or implementing either a subject-matter or learning-based approach to instruction based on the content being addressed. In a subject-matter based approach, learning activities tend to be sequential, student projects tend to be uniform for all students, the use of lectures and/or teacher-directed presentations are the norm as well as traditional evaluation strategies. In a learner-based approach, learning activities are diversified and based mostly on student questions, the teacher serves more as a co-learner or facilitator in the classroom, student projects are primarily student-directed, and the use of alternative assessment strategies including performance-based assessments, peer reviews, and student reflections are the norm.

The characteristics of teachers at this level, as described by Moersch, are consistent with the research regarding the importance of constructivist teaching practices in regards to effectively implementing technology to improve student achievement (Ertmer, 2005). And while the results of this study determined a positive relationship between current instructional practices and the level of technology implementation, there remains a significant gap between this level of practice and the desired level of overall technology implementation.

Research Question Two

Is there is a relationship between the level of personal computer use and the level of technology implementation in a Southwestern School District? This study concluded that there is a statistically significant positive relationship between the level of personal computer use and the level of technology implementation. In other words, teachers who scored higher on the personal computer score were likely to score higher on the level of technology implementation.

The mean score for personal computer use for the participants in this study was 4.77. According to Moersch, teachers at this level of personal computer use are likely to demonstrate a high skill level with using computers for personal use. They should demonstrate the ability to use the computer to create their own web pages, produce sophisticated multimedia products, and/or effortlessly use common productivity applications (e.g., Microsoft Excel, FileMaker Pro), desktop publishing software, and web-based tools. They should also be able to confidently troubleshoot most hardware, software, and/or peripheral problems without assistance from technology support staff.

These results indicate that teachers within this sample should be confident and capable to implement technology into instruction at a high level. However, this is not reflected in the overall LOTI level of the sample. While studies have focused on the lack of skill and the lack of knowledge as reasons teachers do not use technology, Becker (1999) and Fullan (1996) suggest that the beliefs of teachers and the way they think may be a more accurate predictor of technology implementation. This study did not take into account the overall attitudes and beliefs of teachers regarding the importance of technology implementation as it relates to improving student achievement.

Research Question Three

Is there is a relationship between the concentration of poverty within a school and the level of technology implementation in a Southwestern School District? This study concluded that there is no statistically significant relationship between the concentration of poverty within a school and the level of technology implementation. Haycock (1998) suggested that the most important factor in schools that determines the success of the students, even more than race or poverty, is the quality of the teacher. A 2002 study of

New York teachers concluded that poor students, low performing students, and minority students are more likely to have teachers who are inexperienced, uncertified, and/or poorly educated (Lankford, Loeb, Wyckoff, 2002). Within this study, however, 35.1% of teachers in the district possessed an advanced degree, in comparison to the state average of 26.7%. Teachers within this district also averaged 12.1 years of experience, which is only slightly below the state average of 12.7 years. In the United States, students in high poverty are more likely to be taught by teachers with three years or less of experience (Betts, Reuben, & Danenberg, 2002). However, of the 15 schools studied, the lowest average of years of experience was 7.3 years with the highest average being 16.0 years. The schools with the two highest percentages of poverty averaged 15.9 years of experience and 11.2 years, respectively. The school with the highest concentration of poverty, which was 80%, boasted 61.3% of the staff with an advanced degree.

In addition to teacher characteristics often associated with poverty, school climate and culture are often an added challenge. The 2003 Quality Counts survey indicated that schools with high poverty concentrations were more likely to report that student disrespect and parental involvement were problems (Education Week, 20030. The district within which these schools operate maintains a rate in excess of 90% in relation to its bonded indebtedness. In other words, the community has faithfully passed bond issues which enable expenditures on buildings and facilities, including technology. This also indicates a great deal of support within the community for students and schools, regardless of poverty concentrations

Finally, Benard (1996) found that teachers who work with students from poorer families are more likely to feel that their students bring behaviors into the classroom that make teaching difficult and may even feel that they have little or no influence over student learning. In this study, the mean score on the teacher efficacy scale was a 7.58 on a 9 point scale, indicating that overall, the teachers within this sample exhibited a very strong sense of efficacy despite any potential challenges. Question 4 of this research specifically addresses the concept of teacher efficacy.

Research Question Four

Is there a relationship between the level of teacher efficacy and the level of technology implementation in a Southwestern School District? The results of this research proved inconclusive in response to this question. Pearson Correlation (r=.207, p<.05) indicated a statistically significant and moderately strong correlation between teacher efficacy and LOTI. However, regression analysis (b=.057, p>.05) indicated that there is no statistically significant relationship between teacher efficacy and LOTI. This study sought to gain more information on whether or not a teacher's level of efficacy, specifically in the areas of classroom management, student engagement, and instructional strategies were related to the level of technology implementation by teachers. Franklin (2007) suggests teacher efficacy is a key component for technology integration by teachers. She also found that teacher efficacy is related to electronic pedagogical content knowledge. In other words, a teacher's efficacy is related to his or her ability to effectively use technology in the classroom. She further stated that knowing how to use a computer for personal use is a necessary foundation for teachers to reach a level of efficacy in the classroom. However, Franklin's study also suggested that knowing how to use a computer for personal use had no statistically significant correlation to use in the classroom. While some evidence from this current study suggests a correlation between a teacher’s sense of efficacy and the level of technology implementation, the regression analysis indicated no predictive power.

One possible explanation is the unusually high level of efficacy of this sample. With a score of 7.58, the overall average indicated a sample of teachers extremely confident in their ability to influence students and student learning within their classroom. Despite several schools with high concentrations of poverty, the level of efficacy remained high. At the same time, despite the high score on teacher efficacy, the overall level of technology implementation remained well below the target level of 4b. For teachers to change their teaching strategies, they must reach a point of dissatisfaction with the current reality in their classroom (Posner, Strike, Hewson, & Gertzog, 1982, as cited in Wetzel, 2001). Guskey and Pssaro (1993) explained teacher efficacy as “teachers’ belief or conviction that they can influence how well students learn, even those who may be considered difficult or unmotivated (p. 3). With an overall efficacy score of 7.58, teachers within this sample appear to be very confident in their ability to promote student learning under the conditions currently present in their environment. Therefore, the level of teacher efficacy may hinder the desire to improve on the level of technology of implementation.

Research Question Five

Is there a relationship between the level of technology and the following predictor variables: gender; age; attainment of an advanced degree; years of experience; school culture; and principal support? Gender, age, attainment of an advanced degree, years of experience, school culture, and principal support were all determined to have no statistically significant relationship to the level of technology implementation.

Blankenship (1998) found the literature addressing gender as a factor related to computer use to be unclear. While Hayden (1995) found that females are more sensitive to the effects of technology, males tended to view technology more as a tool used to accomplish a task. Anderson and Maninger (2007) found females had better computer access and stronger intentions to use software in teaching. Anderson and Maninger described these results as "surprising" since males are generally thought to have an advantage over females in relation to technology use. Kay (1989), in a study of 383 pre-service teachers, found that males were more likely to use computers more than females. Honeyman and White (1987) found no significant difference between gender and anxiousness about computers in a study of 38 school teachers and administrators. Yuen and Ma (2002) found no statistically significant difference in relation to gender regarding the desire or intent to implement technology into instruction. Finally, it is also important to note that within this current study, the sample consisted of 139 female teachers and only 9 male teachers.

Honeyman (1987) found no significant relationship between age and anxiousness regarding technology. Hayden (1995) also found no significant evidence to support the perception that age is related to the use of computers. Migliorino (2002) found there to be no statistically significant relationship between chronological age and the attitudes of teachers toward the integration of electronic grading software. This current study presents further evidence that age is not a significant predictor of the implementation of technology by teachers. In addition to age, the attainment of an advanced degree was also found to have no statistically significant relationship to the level of technology implementation. The research remains quite limited on the value of an advanced degree and the use of technology by teachers, especially if the advanced degree is not directly related to technology or computer use.

School culture and principal support were also found to have no statistically significant relationship to the level of technology implementation. The mean score for school culture was 5.46, with a mean range of 3.81 to 6.29, indicating that teachers believed it to be somewhat true that their school had a collaborative environment among teachers that supported and encouraged the use of technology to improve the teaching and learning process. The mean score for principal support was 5.60, with a mean range of 4.25 to 6.60, indicating that teachers believed it to be somewhat true that their building principal provided meaningful support that promoted the use of technology to improve the teaching and learning process.

As a leader of change, the principal needs to create a structure with the ability to reduce or eliminate teachers' fears, and at the same time support teachers' efforts to use computer technology even if they are not yet at an ideal level (Hope, 1997). Overall, the teachers within these elementary schools feel supported in their efforts by their building principal. Besides reporting this support on the survey item regarding principal support, teaches also indicated a feeling of a strong sense of efficacy, which might also be attributed to the feeling of support from their building principal. And while the building principals seem to support a collaborative leadership style toward improving teaching and learning through technology, principals must also have a clear vision of technology to support student learning, and they must be promoters and encouragers who see beyond the daily routine and focus on what is possible through the use of technology (Byrom, 1998 as sited in "Critical Issue", n.d.; Guskey, 1998 as cited in Critical issue", n.d., as cited in Lockwood, 1999). While teachers report feeling supported, the fact remains that they are not implementing technology at the desired level of 4B. Further research is required to determine how these building leaders structure the support of technology, plan for professional development, and manage fiscal resources in support of technology implementation in an effort to determine strategies to move from a level of 2 to the desired level of 4B.

Teachers also reported a general belief that they work within a school culture of teachers that is collaborative and supportive in regards to using technology to improve student achievement. Elmore and Burney (1997) suggested that, "Deep and sustained change requires that people feel a personal commitment to each other" and the instructional improvement not be "a collection of management principles but rather the development of "a culture based on norms of commitment, mutual care, and concern" (Elmore and Burney, 1997, as cited in Reitzug, n.d., p. 10). Stevens (1999) found that of six professional development strategies, teachers cited collaboration and networking as the most helpful, noting that it permitted them to share their best practices and benefit from those of others (Stevens, 1999, as cited in Heitzug, n.d.). Teachers need time to discuss technology and other teaching practices with other teachers, and they benefit as a result of time allowed for networking and sharing (Chamberlin & Scot, 2002). "The frequency, breadth, and depth of collaboration with colleagues influences instructional context and the quality of technology use" (Becker and Riel, 2000, as cited in Cradler et al., 2002, p. 52). While the research supports a culture of collaboration among teachers and the teachers within this study reported working in a collaborative culture, the level of technology implementation remains below the desired level. If teachers feel supported by their principal and feel that they work in a collaborative culture of teachers in support of technology, professional development and technology decision making must capitalize on these characteristics. Such conditions should allow for more aggressive change in learning and implementing technology in such a way as to truly impact student achievement.

It is also important to once again emphasize that 10 of the 12 principals serving as leaders of the elementary schools with faculty members participating in this survey have completed a course in using technology in leadership. The course was done in cooperation with the local university and may have had an impact on the results on the reported school culture and principal support.

Limitations

1. While the overall response rate was acceptable, the total sample size was small and the levels of participation from each individual school were varied. In addition, because 58% of the respondents were performing at a Level 2 or below on the LOTI scale, the statistical analysis may not have drawn out factors that might otherwise be significant. The correlation between the various subscales may be underestimated due to the relative homogeneity of the sample (Buckenmeyer & Freitas, 2005). The schools with highest response rates were a reflection of the level of participation each principal had in administering the survey. While some surveys were actually administered during faculty meetings, others were simply placed in teachers' mailboxes with little follow up.
2. Characteristics of the local school district were not considered. It is possible that the level of technology implementation is significantly impacted by the level

of district support, the availability of instructional support, and the overall mission, focus, and priority of the school district.

3. This particular study focuses primarily on the characteristics affecting the use of technology with a focus on second order barriers. First order barriers such as the quality or presence of hardware and the quality or presence of particular software or software programs were not considered in this study.

4. All data analyzed in this study was self reported data. Knowing that technology use in the classroom is generally a desirable characteristic, teachers may have been more likely to rate themselves higher than normal.

5. This study was conducted within a school district that is in the same city as a major research university.

Implications

Larry Cuban (2001) noted that with the ever increasing level of teacher accountability, it is just too hard for most teachers to truly implement technology within their classroom in a way that will impact instruction and thus student achievement. He also noted that computers are hard to use and hard to maintain. Cuban even suggested that we should not expect teachers to put forth the effort to even attempt to use technology to impact student achievement. Despite the criticism of Cuban and others, research has proven that technology can impact student achievement in a positive way, if the proper support is provided to teachers and schools. However, with 58% of the respondents in this study indicating technology use at or below Level 2 on the LOTI framework, significant challenges lie ahead to improve the use of technology to impact student achievement in a positive way. Teachers operating at a Level 2 and below are likely to be using technology-based tools to supplement the existing instructional programs (e.g. tutorials, educational games, basic skill applications) or complement selected multimedia and/or web-based projects (e.g. Internet-based research papers, informational multimedia presentation) at the knowledge/comprehension level. The electronic technology is employed either as extension activities, enrichment exercises, or technology-based tools and generally reinforces lower cognitive skill development relating to the content under investigation. This is significantly different from the target Level 4B. Teachers at Level 4B can be found integrating technology-based tools in a routine manner that provides rich context for students' understanding of the pertinent concepts, themes, and processes. At this level, teachers can readily design and implement learning experiences (e.g. units of instruction) that empower students to identify and solve authentic problems relating to an overall theme/concept using the available technology (e.g. multimedia applications, Internet, databases, spreadsheets, word processing) with little or no outside assistance. Emphasis is again placed on student action and on issues resolution that require higher levels of student cognition processing and in-depth examination of the content. In this study, only 8% of the respondents were using technology at or above the 4B level.

Following an exhaustive research of the literature and the realization of the conclusions learned through this study, the following recommendations are offered to assist practitioners and policy makers in their efforts to increase the level of technology implementation within schools. It is believed that these recommendations will prove significant in moving a greater number of teachers from Level 2 or below to the target level of 4B.

1. Age, years of experience, school culture, principal support, gender, and the attainment of an advanced degree were all found to have no statistically significant relationship to the level of technology implementation. According to this research, the most important factors to transition teachers to higher levels of technology implementation include: the current level of teacher efficacy; the level of personal computer use; and current instructional practices. Each of these three teacher characteristics, through the efforts of this researcher and others, are believed to be significantly related to the level of technology implementation by teachers. Therefore, professional development activities should focus intently on further development of each of these three factors, while also considering that both age and years of experience are related at a statistically significant negative level to both personal computer use and current instructional practices. In order to ultimately increase the level of technology implementation for older teachers with more teaching experience, professional development for these teachers must build a foundation by increasing computer skills for each teacher while also providing extensive training and support to develop a constructivist classroom without technology.

2. Professional development for all teachers must be designed to address computer skills, mastery of the software and hardware involved, and training on how to incorporate the new technology into the classroom in a constructivist manner. Information from the annual Technology Counts survey found the highest priority for technology spending in 47 states and the District of Columbia is for professional development (Swanson, 2006). It is important to remember

that this is long term commitment, as a review of the research suggests that a minimum of three to six years of training is required to affect significant change in a teacher's ability to use technology in such a way to impact student achievement.

3. The purchase of technology must be designed to meet the current needs of teachers. Rather than purchasing technology for the sake of "putting" technology into classrooms, it is important to take a problem-based approach. In other words, what problems are teachers currently facing in relation to student achievement and how can technology assist in their efforts. This allows the professional development to be geared towards not only technology, but also the current problem. In addition, it may impact the teacher's level of efficacy by providing a research based and adequately supported technological intervention to improve student achievement.

4. Decision makers must incorporate the concept of Total Cost of Ownership (TCO) when planning for technology in a school district. While businesses are very familiar with this concept, schools are often less familiar. A 1997 survey of 400 school officials determined that for a school with 75 computers, the average annual cost is $2, 251 per computer (Fitzgerald, 1999). Fitzgerald suggests that the following components be considered when calculating the total costs of purchasing computers and implementing technology: professional development; software; support; ongoing maintenance; and the cost of replacing computers. A second study in Denver suggested that over five years, the support and staff development costs of a $2,000 PC were nearly $1, 944. This represents a support

cost nearly equal to the cost of the hardware purchase, thus essentially doubling the cost of the computer purchase. Very few technology plans consider this when making technology decisions.

A study in California further supported the cost of Total Cost of Ownership. Levinson and Surratt (2000) found that hardware and software costs represent only 40% of the TCO. They suggested the cost of maintenance may average as much as $2,000 per year while the cost of installing and maintaining a technology infrastructure may average $5000 per student over the first five years. Finally, they suggested that professional development can reach 20% of the TCO and upgrades and maintenance can account for up to 12% of the TCO.

The research on TCO must be considered prior to making decisions regarding the purchase of technology. 100% of the teachers in this study had access to at least one computer in their room. In addition, the sample generally reported that it is somewhat true that they work in a culture of collaborative teachers and a supportive principal in regards to supporting technology to improve teaching and learning. Yet, the overall sample reported a 2 on the LOTI, well below the target level of 4B. While computer access is present, quality implementation of technology is not. Support for technology implementation must be considered alongside the actual purchase of technology, to provide any hope of moving to the target 4B level.

Recommendations for Future Research

To contribute to the vast amount of research in regards to technology use within schools, the following suggestions are provided for future research studies:

1. A comprehensive study involving multiple districts including urban/suburban, high poverty/low poverty, and small/large would provide a more comprehensive understanding of school and district characteristics that impact the implementation of technology by teachers. A comprehensive comparison of district support, district expenditures, and district philosophy would provide valuable information in an effort to better understand the current level of technology implementation by teachers. Means et al. (1993) suggested that educational reform requires the consideration of three factors: district, state, and federal components; school factors; and classroom factors such as the individual teacher. This study focused primarily on classroom factors, specifically the teacher with a limited focus on school factors.

2. A mixed methods study including observations of teachers to accompany the surveys is strongly encouraged. Because the level of technology implementation is so low in this study, as well as most studies, identifying potential outliers who implement technology at a high level would provide valuable information to address characteristics of exemplary technology users. Observations should include an analysis of the percentage of instruction impacted by technology and the level of technology use in relation to recommended constructivist attributes.

3. A detailed analysis of the past 3 to 5 years of training and professional development within a school and/or district should be conducted. If a minimum of three years is needed to make a significant impact on the level of technology implementation, it is important to gain an understanding of the amount,

frequency, and quality of technology professional development teachers have received prior to beginning any new efforts.

4. Conducting an action research project such as repeating this study after the implementation of a significant intervention would provide valuable information for school practitioners. One example would be to compare the current overall LOTI level to the overall LOTI level after a three year focus on improving teacher's computer use skills or moving teachers from traditional to constructivist teaching styles. This would allow a school district to focus professional development to meet the teachers at their current operational level while also providing an evaluation mechanism to determine the economic prudence of the district focus, including both time and money.

Summary

The evidence suggests it, most teachers believe it, and most students want it. Technology properly integrated into the classroom has a significant positive impact on student achievement. After nearly three decades of ever increasing expenditures on technology, most schools, classrooms, and teachers can boast about the presence of technology. However, as suggested in this study, a very small percentage of classrooms and teachers have transformed the "presence" of technology in to meaningful differences in teaching and learning. It is hopeful that the findings of this study, along with the implications and suggestions for further research, will provide a cornerstone for future efforts to include technology in schools and classrooms. Technology in and of itself, as mentioned in the opening remarks of this study, is not a silver bullet to improve teaching and learning. Decisions to improve technology implementation must focus on building capacity; the capacity of teachers and students to use the computers as well as the capacity of schools and districts to support use in a way that impacts both teaching and learning (Coppola, 2005). With the understanding of what factors may influence the level of technology implementation, school and community leaders can focus on creating a culture within the school that is conducive for teachers to truly implement technology in a way that will impact student achievement.

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APPENDIX A

From : <mark_grabe@und.nodak.edu>
Sent : Saturday, March 31, 2007 2:36 PM
To : Jason Brunk <brunkjason@hotmail.com>
Subject : Re: teacher centered vs learner centered

We have no objection to material from our books being used in dissertations and are pleased you have found the material to be useful.

Mark Grabe
Department of Psychology - University of North Dakota
Grand Forks, ND 58202

Dear Dr. Grabe,

I am a student at the University of Oklahoma pursuing my EdD in Educational Administration, Curriculum and Supervision. I am currently working on my dissertation. I am hoping I can get your permission to use a table from one of your publications to include in my literature review. I think it does a tremendous job of comparing teacher centered vs learner centered (traditional vs constructivist for the sake of my paper). I have included in the body of this email a rough draft of my study design for you to see, and I have also attached the table in the form I hope to use.

Thank you in advance for taking the time to consider my request.

Sincerely,

Jason Brunk
brunkjason@hotmail.com
1-405-350-3318

APPENDIX B

Factors Affecting the Level of Technology Implementation by Teachers in Elementary Schools

Thank you for taking the time to participate in this survey. As you read on the consent form you were provided, your participation in this survey is strictly voluntary. Please take the time to read each question carefully and provide an honest response to each of the items on the survey. Your answers will remain confidential and anonymous. This survey consists of 69 questions in three sections. It is expected this survey will take between 15 and 25 minutes to complete. At the conclusion of this study, feedback will be provided to your district in aggregate format. Thank you for your participation.

Section I

1. Please circle the elementary school in which you spend the majority of your day:

Adams	Cleveland	Eisenhower	Jackson	Jefferson
Kennedy	Lakeview	Lincoln	Madison	McKinley
Monroe	Roosevelt	Truman	Washington	Wilson

__________ 2. Please indicate your current age.

__________ 3. Please indicate the number of years of experience you have as a classroom teacher, including this current school year.

__________ 4. Have you completed an advanced degree (e.g. Master's or Doctorate)?

__________ 5. Please indicate your gender (e.g. male or female).

Based on the following scale, please assign a numerical score to answer the two questions that follow.

0	1	2	3	4	5	6	7
N/A	Very untrue			Somewhat true			Very true

__________ 6. My school culture includes a collaborative environment among teachers that supports and encourages the use of technology to improve the teaching and learning process.

__________ 7. My building principal(s) provide(s) meaningful support that promotes the use of technology to improve the teaching and learning process.

Thank you for completing Section I. Please turn the page to begin Section II. Section II consists of 50 questions.

Section II
Read each response below and assign a numerical score based on the following scale:

0	1	2	3	4	5	6	7
N/A	**Not true of me now**		**Somewhat true of me now**		**Very true of me now**		

1. Score______
I frequently engage students in learning activities that require them to analyze information, think creatively, make predictions, and/or draw conclusions using the classroom technology resources.

2. Score______
I frequently present information to students using multimedia presentation or electronic "slideshows" to reinforce the content standards that I am teaching and better prepare students to take standardized tests.

3. Score______
I have trouble managing a student-centered classroom using the available technology resources and would welcome the help of a peer coach or mentor.

4. Score______
Students in my classroom design either web-based or multimedia presentations that showcase their research (e.g. information gathering) on topics I assign in class.

5. Score______
I frequently assign web-based projects to my students as a means of emphasizing specific complex thinking skill strategies aligned to the content standards.

6. Score______
My students collaborate with me in setting both group and individual academic goals that provided opportunity for them to direct their own learning aligned to the content standards.

7. Score______
Using the most current and complete technology infrastructure available, I have maximized the use of the learning technologies in my classroom and at my school.

8. Score______
Problem-based learning is common in my classroom because it allows students to use the classroom technology resources as a tool for higher-order thinking and personal inquiry.

9. Score______
I use the classroom technology resources exclusively to take attendance, record grades, present content to students, and/or communicate with parents via email.

10. Score______
My students identify important school/community issues or problems, then use multiple technology resources as well as human resources beyond the school building (e.g., partnerships with business professionals, community groups) to solve them.

11. Score______
My students use the classroom technology resources most frequently to improve their basic math and literacy skills via practice testing software, integrated learning systems (ILS), or tutorial programs.

12. Score______
Constant technical problems prevent me and/or my students from using the classroom technology resources during the instructional day.

13. Score______
I am proficient with basic software applications such as word processing tools, internet browsers, spreadsheet programs, and multimedia presentations.

14. Score______
My students frequently discover innovative ways to use our school's advanced learning technologies to make a real difference in their lives, in their school, and in their community.

15. Score______
I can solve most technical problems with our classroom's technology resources during the instructional day without calling for technical assistance.

16. Score______
Locating quality software programs, websites, or CD's to supplement my curriculum and reinforce specific content standards is a priority of mine at this time.

Read each response below and assign a numerical score based on the following scale:

0	1	2	3	4	5	6	7
N/A	Not true of me now		Somewhat true of me now		Very true of me now		

17. Score______
Though I may use technology for teacher preparation, I am not comfortable using my classroom technology resources as part of my instructional day.

18. Score______
I am comfortable training others in using basic software applications, browsing/searching the Internet, and using specialized technologies unique to my grade level or content area.

19. Score______
Computers and related technology resources in my classroom are not used during the instructional day, nor are there any plans to include them at this time.

20. Score______
I consistently provide alternative assessment opportunities that encourage students to "showcase" their understanding of the content standards in nontraditional ways.

21. Score______
My students use the Internet for (1) collaboration with others, (2) publishing, (3) communication, and (4) research to solve issues and problems of personal interest that address specific content standards.

22. Score______
My students participate in online collaborative projects (not including email exchanges) with other students, government agencies, or business professionals to solve their self-selected problems or issues.

23. Score______
Given my current curriculum demands and class size, it is much easier and more practical for my students to learn about and use computers and related technology resources outside of my classroom (e.g., computer lab, resource center).

24. Score______
I use the classroom technology resources most frequently to locate lesson plans I can use in class that are appropriate to my grade level and are aligned with our content standards.

25. Score______
My current instructional program is effective without the use of technology; therefore, I have no current plans to change it to include any technology resources.

26. Score______
I use our technology resources daily to access the Internet, send email, and/or plan classroom activities.

27. Score______
Due to time constraints and/or lack of experience, I prefer using instructional units recommended by my colleagues that emphasize complex thinking skills, student technology use, content standards, and student relevancy to the real world.

28. Score______
My students' creative thinking and authentic problem-solving opportunities are supported by the most advanced and complete technology infrastructure available.

29. Score______
My personal professional development involves investigating and implementing the newest innovations in instructional design and learning technologies that take full advantage of my school's most current and complete technology infrastructure.

30. Score______
I can locate and implement instructional units that emphasize students using the classroom technology resources to solve "real-world" problems or issues, but I don't usually create them myself.

31. Score______
I have an immediate need for some outside help with designing student-centered performance assessments using the available technology that involve students applying what they have learned to make a difference in their school/community.

32. Score______
Students' use of information and inquiry skills to solve problems of personal relevance guides the types of instructional materials used in and out of my classroom.

Read each response below and assign a numerical score based on the following scale:

0	1	2	3	4	5	6	7
N/A	**Not true of me now**		**Somewhat true of me now**		**Very true of me now**		

33. Score______
My instructional use of our classroom technology resources is frequently altered according to the latest innovations and research in the areas of instructional technology, teaching strategies, and/or learning theory.

34. Score______
I regularly implement a student-centered approach to teaching that takes advantage of our classroom technology resources to engage students in their own learning.

35. Score______
I frequently consider (1) my students□ interests, experiences, and desire to solve relevant problems and (2) the available human resources outside of the school when planning student-centered learning activities that include technology.

36. Score______
Students taking meaningful action at school or in the community relating to the content standards learned in class is an essential part of my approach to using the classroom technology resources.

37. Score______
I have an immediate need for professional development opportunities that place greater emphasis on using my classroom technology resources with challenging and differentiated learning experiences rather than using specific software applications to support my current lesson plans.

38. Score______
My students create their own web pages or multimedia presentations to showcase what they have learned in class rather than preparing traditional reports.

39. Score______
The types of professional development offered through our school system does not satisfy my need for more engaging and relevant experiences for my students that take full advantage of both my “technology” expertise and personal interest in developing learner-based curriculum units.

40. Score______
My students frequently use the classroom technology resources for research purposes that require them to investigate an issue/problem, think creatively, take a position, make decisions, and/ or seek out a solution.

41. Score______
Having students apply what they have learned in my classroom to the world they live in is a cornerstone to my approach to instruction and assessment.

42. Score______
Curriculum demands, scheduling, and/or budget constraints at our school have prevented me from using any of the available technology resources during the instructional day.

43. Score______
I am skilled in merging the classroom technology resources with relevant and challenging, student-directed learning experiences that address the content standards.

44. Score______
Though I currently use a student-centered approach when creating instructional units, it is still difficult for me to design these units on my own to take full advantage of our classroom technology resources.

45. Score______
My immediate professional development need is to learn how my students can use our classroom technology resources to achieve specific outcomes aligned to the content standards.

46. Score______
It is easy for me to identify and implement software applications, peripherals, and web-based resources that support student’s complex thinking skills and promote self-directed problem solving.

Read each response below and assign a numerical score based on the following scale:

0	1	2	3	4	5	6	7
N/A	**Not true of me now**		**Somewhat true of me now**		**Very true of me now**		

47. Score______
My students have immediate access to all forms of the most advanced and complete technology infrastructure available that they use to pursue problem-solving opportunities surrounding issues of personal and/or social importance.

48. Score______
I need access to more resources and/or training to begin using the available technology resources as part of my instructional day.

49. Score______
I regularly use different technology resources for personal or professional communication and planning.

50. Score______
Students' questions and previous experiences heavily influence the content that I teach as well as how I design learning activities for my students.

Thank you for completing the 50 questions in Section II. Please turn the page to complete Section III of this survey. Section III consists of only 12 questions.

Section III

Teacher Beliefs	How much can you do?								
Directions: This section of the questionnaire is designed to help us gain a better understanding of the kinds of things that create difficulties for teachers in their school activities. Please indicate your opinion about each of the statements below by filling in the oval surrounding the appropriate number. Your answers are both confidential and anonymous.	Nothing		Very Little		Some Influence		Quite a Bit		A Great Deal
1. How much can you do to control disruptive behavior in the classroom?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2. How much can you do to motivate students who show low interest in school work?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
3. How much can you do to get students to believe they can do well on their school work?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
4. How much can you do to help your students value learning?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
5. To what extent can you craft good questions for your students?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
6. How much can you do to get children to follow classroom rules?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
7. How much can you do to calm a student who is disruptive or noisy?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
8. How well can you establish a classroom management system with each group of students?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
9. How much can you use a variety of assessment strategies?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
10. To what extent can you provide an alternative explanation or example when students are confused?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
11. How much can you assist families in helping their children do well in school?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
12. How well can you implement alternative strategies in your classroom?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

APPENDIX C

Building Principal Questionnaire

1. How many teachers do you have in your building that fit the criteria of "**employed full time and serves as the primary instructor in a classroom for at least ½ of the school day.**" This information is critical for me to address the response rate of the survey.

2. What is the current percentage of students within your school who qualify for free or reduced lunch?

3. Because much of my research is related to the percentage of poverty within each school (as determined by the number of students who qualify for free or reduced lunch prices), I need to know if you did anything to encourage students and parents to turn in their lunch application forms (i.e. class party if 100% of the forms are turned in, drawings, etc.). Members of my committee feel such efforts could influence the accuracy of the rate, so this information is very important.

4. Have you, as the building principal, been engaged in any type of extensive technology training (i.e. OKACTS, Techmaster, Intel Teach to the Future, etc.)? If you have been, please list the type of training and the approximate year that you went through the training.

5. Has your staff been involved in any type of extensive technology training as an entire faculty (i.e. technology integration training, etc.)?

6. What technology, if any, does **every** classroom in your building contain (i.e. TV, computer, digital projector, smart board, etc.)?