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THE IMPACT OF INSTRUCTIONAL TECHNOLOGY TRAINING AND SUPPORT:
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Dedication

This dissertation is dedicated to my wonderful husband and best friend, Mark, and our sons Aaron and Colby. Not one of them even raised an eyebrow when, after completing two normal careers, I said, “I want to go to graduate school.” Without their support, encouragement, and love, this accomplishment would not have been possible.

I also dedicate this achievement to my parents, Henry and Bernita Graddy, who always encouraged me to work harder and learn more, and I know they will be there with me in spirit at the commencement ceremony, just as they have been throughout my life.

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Abstract

Despite the increase in technology available to classrooms, results of the research on the impact of technology on student achievement have been mixed at best. Studies consistently show that if technology is effectively integrated into curriculum, it is much more likely to affect student learning, however, researchers have identified numerous barriers to the successful integration of technology.

This qualitative case study examines the experiences of teachers, administrators, and a technology director engaged in technology implementation programs in a technology-rich school, in an effort to identify structures, conditions, and characteristics of instructional technology training and support that seem to contribute to or detract from a school's successful implementation of technology.

CHAPTER ONE

Introduction

The use of technology has become an integral part of almost every facet of life, and today's students live in a digital world that is changing daily. The current generation of kindergarten through twelfth grade students has never lived in a world without computers, social media, digital music players, smartphones, tablets, and satellite radio and television. Digital technologies are or soon will be a part of almost every student's daily life, both in and out of school. In recent years, the world of digital technologies has expanded far beyond the desktop computer. A survey of over 3,000 participants conducted in 2010 by the Pew Research Center, Pew Internet & American Life Project shows that 85% of American adults and 75% of teenagers now own a mobile phone. Over 76% of American teenagers own desktop or laptop computers, and 42% own home gaming devices (Smith, 2010). Although technology is ubiquitous in American society, the ways in which we educate our children seem to be considerably less progressive.

The U. S. Department of Education Office of Education Technology, in the National Education Technology Plan (NETP) of 2010, finds that at the close of that year the United States ranked ninth out of 36 developed nations in college completion rates. To regain leadership in this area, the NETP calls for integrating the advanced technologies that are used in our daily personal and professional lives into our education system, and calls for the use of state-of-the-art technology to "enable, motivate, and inspire all students to achieve, regardless of background, languages, or disabilities." (U.S. Department of Education, 2010). The Plan further recommends that educators be provided access to content, resources, information, peers, and experts to provide the best

possible educational experiences. Wise (2008) confirms that there is a crisis in student achievement in American high schools, and the Federal Communications Commission spends billions of dollars annually (through the eRate program) on information technology infrastructure in an effort to help schools meet the technology needs of their students and teachers.

The availability of instructional technologies to K-12 classrooms has increased dramatically in the past two decades (Staples, Pugach, & Himes, 2005; Wells & Lewis, 2006). In 1996, only one out of every four adults had access to online services, and only 14% of the nation's classrooms had access to the Internet (U. S. Department of Education National Center for Education Statistics, 2000; QED, 2001). By the end of 2002, 98% of all public schools reported access to the Internet (U. S. Department of Education National Center for Education Statistics, 2002). The range of instructional technologies available to teachers and students is ever widening, and the decline in prices has made these technologies available to many more teachers and students. In 2008, educational technology spending reached $47.7 billion, and that figure was expected to top $56 billion by the end of 2012 (Compass Intelligence, 2012). In reality, education spending on information technologies in the United States reached $50 billion in 2011, and projections show that technology investment will continue to steadily rise to over $59 billion in 2016 (Compass Intelligence, 2012). Over 68% of teachers responding to a technology use survey in 2013 expressed a desire for more classroom technology, a figure that rises to 75% among teachers in low-income schools ((PBS LearningMedia, 2013).

There is increasing evidence that the use of technology as a tool in authentic, student-centered learning activities can positively influence student learning (Atkins, Bennett, Brown, Chopra, Dede, & Fishman, 2010; Barnett, 2003; Hoffner, 2007; McKenzie, 2000; O'Bannon & Puckett, 2007; Wenglinsky, 2006). In a national survey of over 500 pre-K through Grade 12 teachers, PBS Learning Media (2013) finds that 74% of teachers surveyed believe that the use of educational technology increases their ability to reinforce and expand on content and to motivate students, and 73% believe technology increases their ability to respond to a variety of learning styles.

The impact that technology integration can have on student achievement seems to be more dependent on *how* technology is used than on the technology itself. Student-centered, technology-rich educational opportunities and programs that include high-quality professional development, robust content that is aligned to standards, and individual student attention and support result in improvements in student engagement and achievement, teacher effectiveness and retention, and increases in college-going rates (Bennett, Persky, Weiss, & Jenkins, 2007; National Education Technology Plan, 2010; O'Hair & Reitzug, 2006). In a survey of middle school students, Lei and Zhao (2007) find that those who used technology to manipulate data or to construct their own knowledge experienced an increase in grade-point averages over the course of one school year.

While it is evident from a considerable body of research that the potential impact of technology-rich learning on student achievement can be great, there are also many indications that the anticipated level of success is not being reached (Ertmer & Ottenbreit-Leftwich, 2010). In many classrooms, teachers are using technology primarily

for administrative tasks rather than as a component of their instruction (Hayes, 2007; Wells & Lewis, 2006; Zhao & Bryant, 2006). In a survey of technology coordinators at 1,012 schools, Wells and Lewis (2006) find that computers were used predominantly for accessing online assessments and test data, rather than in support of student-centered learning activities.

The PBS LearningMedia survey (2013) finds that a high percentage of teachers generally classify the various technology tools in their classrooms as primarily teaching tools used by teachers, with considerably fewer teachers viewing technology as tools for student self-learning. Although these uses of technology may ease teacher workload, they do not provide student-centered learning experiences that are supported by the literature. Studies show that learning opportunities in K-12 classrooms should include the use of the same types of technologies students will encounter in higher education and in the world of work (An & Reigeluth, 2011; Cornelius-White & Harbaugh, 2009; Ringstaff & Kelley, 2002).

Problem

Despite the increase in technology available to classrooms, the research on the impact of technology on student achievement has been mixed at best. Studies consistently show that if technology is effectively integrated it is much more likely to affect student learning, however, researchers have identified numerous barriers to the successful integration of technology into curriculum. Two of the most often-cited barriers are the lack of adequate technology professional development and inadequate hardware/software support (Bingimlas, K., 2009; Hew & Brush, 2007; Hinson, LaPrairie, & Heroman, 2006; Hixon & Buckenmeyer, 2009).

Many studies verify the need for ongoing quality professional development, along with day-to-day support, for teachers to make the best use of instructional technology to enhance student achievement (An & Reigeluth, 2011; Bingimlas, 2009). Green (2010) finds that professional development that enhances teachers' ability to seamlessly integrate the technology tools into content was far more valuable than simple "how-to-use training." To reach the goal of technology-rich learning environments, teachers require hands-on training and high-quality ongoing support in developing instructional materials, assessing student performance, and expanding their content knowledge to include instructional technologies (An & Reigeluth, 2011; Peck et al., 2011; Zhao & Bryant, 2006).

Studies indicate that technical support may be as important to the integration of technology into curriculum as is the availability of current hardware, software, and network connectivity (Kramer, Walker, & Brill, 2007). Teachers working toward technology integration find they must develop a new and complex set of skills. Not only must they learn to operate new technology and integrate it into their content, they also must develop new problem-solving abilities, and the ability to troubleshoot issues when they occur (An & Reigeluth, 2011). Unless the technology is easily accessible, reliable, and consistent in performance, teachers are likely to be discouraged from making it a part of their practice (Peck et al., 2011).

Without ongoing professional development and timely, high-quality technology support, teachers and students suffer dissatisfaction and frustration, and the likelihood that existing technology will be used, or that new technology efforts will be embraced, is diminished (Ebersole & Vorndam, 2002; Koul, Maynard, Ala'I, & Edmonds, 2011;

McNierney, 2004). Teachers will not use technology if it does not work consistently, quickly, and with little overhead in terms of teacher time spent in preparation and troubleshooting (Hew & Brush, 2007; McNierney, 2004; Ringstaff & Kelley, 2002; Staples et al., 2005). In a study of the relationship between technology support and technology integration into college-level foreign language curricula, Green (2010) finds significant correlation between the nature and level of technology support available to instructors and the extent of technology integration achieved in their teaching.

Many schools lack trained on-site technology training and support personnel to provide prompt and effective responses to support requests, or to properly maintain hardware and networks (Fulton & Sibley, 2003; Granger, Morbey, Lotherington, Owston, & Wideman, 2002; Wetzel, 1999). In the National Education Technology Plan of 2010, the U. S. Department of Education Office of Education Technology acknowledges that schools and districts need innovation in the organizations that support educators in their use of technology resources, and emphasizes that technology support structures must be updated to serve the increasingly varied uses of technology in today's classrooms. Districts, states, and the private sector should work together to develop technology support models for teachers and students using both school and student-owned devices, including improved security and filtering systems, as well as personnel and systems to provide around-the-clock support for technology used for learning (NTEP, 2010).

Background of the Problem

Although the potential impact of technology on teaching and learning is great, the reality has been disappointing (Ertmer & Ottenbreit-Leftwich, 2010). Too much classroom technology remains unused or underused. Schools are learning a painful

lesson, that merely installing expensive networks and putting computers in the hands of students can result in what Jamie McKenzie terms the "educational equivalent of *red ink*…the observable failure of schools to actually use their network or computers to any meaningful extent…."(McKenzie, 1999, p. 1). Many teachers report little or no use of technology in their instruction, or use technology only in traditional, teacher-centered ways that amount to nothing more than automating traditional methods such as drill and practice (Ertmer & Ottenbreit-Leftwich, 2010; Mishra & Koehler, 2006; U.S. Congress Office of Technology Assessment, 1995; U. S. Department of Education National Education Technology Plan, 2010). Technology infrastructures continue to expand, but there is widespread concern that instructional technology remains underutilized (Hixon & Buckenmeyer, 2009). As the lives of students and teachers outside of school include more and more use of technology, there have been relatively modest gains in classroom technology use (Means, 2010). Large-scale national surveys of teacher uses of technology show an increase in teacher use for non-instructional purposes, but no significant increase in the level of technology-based learning activities for students (Bakia, Means, Gallagher, Chen, & Jones, 2009).

There is an increasingly wide variety of instructional technology available for classrooms, and effective technology support is no longer just a matter of computers and networks; integration of technology into the curriculum must be addressed. Rapidly advancing software capability is outpacing the hardware infrastructure at most schools, and compatibility issues, especially between legacy hardware and emerging software and web-based resources, pose additional challenges to schools' efforts to adequately support students, teachers, and administrators (U. S. Department of Education National Education

Technology Plan, 2010). With the exponential growth of resources available for web-based research, lack of effective technology support may prevent teacher and student access to some of the most significant learning tools in history (Callister & Burbules, 2004). Teachers, students, administrators, and technology leaders in today's schools face a rapidly growing level of technology use for both educational and administrative purposes, which places significantly increased demand on commonly under-staffed and under-trained support personnel (Carter, 2000).

For instructional technology to become an integral part of classroom instruction, teachers must develop a comfort level with its use through effective professional development, adequate time to practice, and readily available support in both the operation of the technology and its integration into curriculum. Granger, et al. (2002) find that "full-time technical support is as necessary as the machines themselves if teachers are to surpass the basic logistical and technical problems of computer use in order to move on to the more significant, and sought-after, components of implementation, namely curricular integration and meaning-making" (p. 33).

An example of the scarcity of technology support in schools is highlighted in a survey of more than 600 school district leaders and technology administrators in 2008. Researchers show that only 31 percent of respondents said their districts have enough information technology (IT) staff to support their needs. Fifty-five percent said they spend more than half their time reacting to technical problems, instead of planning and assisting teachers with technology integration. Other key findings from the survey include:

- The ratio of computer users to total IT staff in U.S. schools is nearly 500 to 1; industry best practices say it should be no more than 150 to 1.
- Over 72 percent of respondents said they do not have sufficient IT staff to integrate technology into their classrooms effectively. More than 71 percent said they do not have sufficient IT staff to implement new technologies, and 69 percent said they do not have enough staff to support their needs overall.
- Over 68 percent of respondents said the number of technology devices in their schools has increased in the last year, but 66 percent said IT staffing hasn't kept pace with these changes (eSchool News, 2008).

Purpose

The purpose of this study is to examine the experiences of teachers, administrators, and technology directors engaged in technology implementation programs in a technology-rich school, in an effort to identify structures, conditions, and characteristics of instructional technology training and support that seem to contribute to a school's successful integration of instructional technology into curriculum. The study addresses a gap in existing literature concerning the importance of the role of instructional technology training and support in the use of classroom technologies, and provides recommendations to schools seeking to integrate technology into their teaching.

Research Question

To build on the existing literature and further examine the issue of school technology training and support and its implications, this case study investigates a technology-rich school in an effort to answer this research question:

What structures and conditions for instructional technology training and support do teachers, school leaders, and technology directors identify as critical to the success of their classroom technology integration efforts?

Context

The need for this study is based on my six years' experience working with recipients of a technology and professional development grant program, where I gained first-hand knowledge of the importance of technology training and support to teachers working to implement instructional technologies. The need for more readily available, qualified technology training and support was the challenge I encountered most often in my work supporting teachers in their technology use.

The highly competitive grant program begins with Phase I, when administrators receive a laptop computer to enable them engage in collaborative networking with the goal of improving student achievement and facilitating the development of practices necessary to bring about systemic whole school change. Administrators engaged in Phase I attend a two-day leadership seminar, take an on-line technology assessment, participate in a year-long program of cluster meetings, and develop an action plan for the implementation of one of the "Ten Practices for High Achieving Schools" (O'Hair, McLaughlin, & Reitzug, 2000). Upon the administrator's successful completion of Phase I, the school may apply for the Phase II technology implementation grant, which provides funds for the purchase of instructional technology equipment, along with extensive yearlong professional development in the use and integration of the technology into teaching. At the end of each grant implementation year, recipient schools are evaluated based upon a specific set of performance factors that measure the level of successful

technology integration and leadership team development. The school selected for this study, a recipient of the technology grant in 2009-2010 school year, was evaluated as high-performing and experienced significant growth during the implementation school year based on the granting agency's assessment criteria.

Definition of Terms

Technology integration refers to the use of technology as a learning tool that is closely linked with content standards and integrated into ongoing classroom work, rather than taught as a separate or stand-alone subject (Barnett, 2003). It can be grouped into three broad categories: technology for preparation of instruction, technology for delivery of instruction, and technology as a learning tool (Inan & Lowther, 2010). It is important to distinguish between lower and higher levels of integration. At lower levels of technology integration, students are typically passive in their participation, while higher levels of integration involve students actively engaged and involved in complex, cooperative problem solving, often project-based learning experiences (Dwyer, Ringstaff, & Sandholtz, 1990).

Authentic instruction is a combination of instruction and assessment designed to improve student achievement using lessons taught at a higher intellectual level, and that contain information and skills that are of value beyond school (Dennis & O'Hair, 2010; Newmann, Bryk, & Nagaoka, 2001). The components of authentic instruction are construction of knowledge, disciplined inquiry, value beyond school, and implicit view of students (Newmann, Secada, and Wehlage, 1995; Newmann and Wehlage, 1995). O'Hair, McLaughlin, and Reitzug (2000) find that when teaching is focused on the development of understanding and meaning, and connected to students' life experiences,

students had greater success on assessment of advanced skills as well as standardized tests.

Technology-rich learning environments are environments that are designed for an instructional purpose that includes technology to support the learner in achieving the goals of instruction (Lajoie & Azevedo, 2006). They provide students with the opportunity to use technology to gather, organize, and analyze information, and use their findings to solve problems or create products (Poitras, Lajoie, & Hong, 2012). Teachers act as facilitators rather than distributors of knowledge, assisting students as they engage in collaborative activities to construct their own knowledge (O'Hair et al, 2000; Newman & Wehlage, 1995).

Instructional technologies referred to in this study include, but are not limited, to computers and Internet resources, interactive white boards, digital projectors, student response systems, communications technologies, handheld mobile computing devices, computer software applications, audio and video recording devices, and digital cameras.

Technology support in this study encompasses both instructional or pedagogical support and technical or operational support (Ronnkvist, Dexter, & Anderson, 2000). Instructional technology support deals with instructional strategies, pedagogies, and teaching methods. Technical support includes operational maintenance and troubleshooting of hardware, software, and networks (CEO Forum, 1999; Dexter, Anderson, & Ronnkvist, 2002).

Technology support structures include, but are not limited to, single-session and ongoing technology professional development, facilities, support staff (both pedagogical and operational technical support), mentoring programs, and collaborative teacher

activities such as peer training and demonstration classroom sessions. The CEO Forum's School Technology and Readiness Report (2001) emphasize four key elements of an effective technology support program, including helping teachers integrate, not just operate technology; regularly-scheduled technology-oriented professional development as well as just-in-time and one-on-one support; technology resources located convenient to their classrooms; and inclusion of all teachers in technology-oriented support opportunities.

Significance

There is considerable evidence that the use of technology as a tool in authentic, student-centered learning activities can positively influence student achievement, yet much of classroom technology remains unused or used only to support traditional teaching practices. As technology availability and complexity continue to expand, it is incumbent upon educators to work to ensure that the technology available to teachers and students is used in the most effective ways to benefit student achievement. Although a barrier to successful technology integration that appears in many studies is the lack of qualified, timely technology training and support, few researchers have addressed the issue of support and its effect on successful creation of technology-rich learning environments.

This study focuses on the technology training and support issue by examining the experiences of a school that achieved success in a technology grant program that provided hardware as well as professional development, and addresses a gap in the literature concerning the level of and types of instructional technology training and support necessary for successful technology implementation. The subject school

received evaluations as high performing and showing significant growth based on the evaluation instruments of the grantor. The goal is to learn what factors, conditions, and structures that teachers, school leaders, and the technology director identify as contributing to or detracting from their level of success.

Method

This study answers the research question using a qualitative case study, "an in-depth description and analysis of a bounded system" (Merriam, 2009, p. 40). An in-depth study of the selected case, anchored in real-life situations, can result in rich understanding of the phenomenon, and have impact on and even improve practice (Merriam, 2009). The particularistic, descriptive, and heuristic features of a case study can provide valuable insights into relationships and variables, and provide greater understanding of experiences (Stake, 2007). Qualitative case studies, like other forms of qualitative research, involve "the search for meaning and understanding, the researcher as the primary instrument of data collection and analysis, an inductive investigative strategy, and the end product being richly descriptive" (Merriam, 2009, p. 39). Creswell (2007) offers a more detailed definition of case study research, describing it as "a qualitative approach in which the investigator explores a bounded system (a *case*) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving *multiple sources of information* (e.g., observations, interviews, audiovisual material, and documents and reports), and reports a case *description* and case-based themes" (p. 73). Yin (2008) describes case study research as having a distinct advantage in answering "how" and "why" questions.

The bounded system selected for this study is a school where I served as the primary facilitator of monthly technology professional development for a period of one school year, during the technology grant implementation. Data collected and analyzed in this study includes transcripts of interviews with teachers, the school's superintendent, and the school technology director; observations, field notes, and journal entries; and assessment and evaluation documents from the grant. Each of the three sets of data was coded to identify categories or themes, followed by cross-set comparison to add to the validity of the findings. All data sources work together to provide answers to the research question.

Summary

Although the potential for positive impact of technology on teaching and learning is great, the reality has been disappointing. Too much classroom technology remains unused or underused, and many teachers report using technology only for administrative or traditional, teacher-centered tasks. This study examines the experiences of one school's technology-integration efforts, and identifies the structures and conditions that teachers, administrators, and technology directors identify as contributing to the success of those efforts.

My hope is that the results of this case study add to the body of research and provide administrators, technology coordinators, and teachers with insight and guidelines for using school technology plans, structures, and processes to increase the effectiveness of technology integration in the classroom, and positively affect student achievement.

CHAPTER TWO

Review of the Literature

The goal of this chapter is to examine existing literature that addresses the use of technology to enhance student learning. This review forms a framework to guide this case study, and begins with investigating connections between classroom technology use and student achievement. It continues with a review of research into the ways technology should be used in the classroom in order to provide the greatest impact on student achievement, and then moves to an examination of studies that identify barriers that schools have experienced in integrating technology into curriculum. This case study narrows the focus to one of the most-often cited barriers to technology integration, the lack of effective technology training and support, which includes technology-based professional development, ongoing curriculum integration support, and technical or operational support.

Connections Between Technology Use and Student Achievement

Many researchers describe the use of technology in teaching as an essential skill for teachers, because technology can make complex concepts and ideas more accessible to students, while helping them prepare to meet the demands of the modern workplace. A number of studies identify connections between student use of technology and increased student engagement and achievement, and there is evidence that comprehensive, technology-rich education initiatives that include high-quality professional development and support, robust content aligned to standards, and attention to individual student needs result in improved student engagement and achievement as

well as teacher effectiveness and retention, and increases in college-going rates (Lee and Lind, 2010; U.S. Department of Education, 2009, 2000).

Studies show that the use of technology to support learning in student-centered ways can positively affect student achievement (Abramovich, 2006; Brown, 2007; Machin, McNally, & Silva, 2007; Peslak, 2004). Lei and Zhao (2007) find in a study of 130 middle school students that those who used technology to manipulate data or to construct representations of their knowledge experienced an increase in grade-point averages over the course of a school year. These findings are supported by the work of Forcier and Descy (2008) and Jonassen, Howland, Marra and Crismond (2008), who suggest that the use of technology in student-centered learning activities enhances curriculum, motivates students, and improves student success in learning subject-specific content.

In an analysis of data from 950 fifth grade students and 290 teachers from 18 elementary schools across West Virginia, researchers study the effects of the use of the West Virginia Basic Skills/Computer Education (BS/CE) program, which concentrates on spelling, vocabulary, reading, and math. They find that the level of student use of the BS/CE program had a positive effect on test scores. The study determines that the use of technology accounted for as much as 11% of student improvement on basic skills (Mann, D., Shakeshaft, C., Becker, J., & Kottkamp, R. 1999).

Using the National Assessment of Educational Progress (NAEP) database, Harold Wenglinsky (1998) studies the link between student computer use and test performance. Results from NAEP assessments in mathematics, science, and reading for fourth and eighth graders indicate that the quality of work with technology was more important than

quantity. Wenglinsky examines the effects of technology use on 6,227 fourth grade students and 7,146 eighth grade students, controlling for socioeconomic status, class size, and teacher characteristics. When students used computers to work through complex problems engaging higher order thinking skills, greater benefit was realized. Eighth grade students who used the programs progressed up to 15 weeks above grade level, and fourth grade students progressed three to five weeks ahead of students who did not use the technology. These analyses also reveal that teachers were typically not using technology in the most effective ways – using computers "as drilling machines rather than as catalysts for creativity (p. 3)."

In a 2001 study of NAEP results for 12th grade history students, Wenglinsky (2006) finds that the use of technology for traditional high school academic tasks resulted in positive impact on test scores. He suggests that lessons should not be planned around the technology, but that teachers should approach lesson planning with the idea that students will use the technology available to them to research and complete assignments and to enhance their own learning. In a study of laptop use by 259 California middle school students over a three-year period, Gulek and Demirtas (2005) collected data that includes over-all cumulative grade point averages, end-of-course grades, writing test scores, and state-mandated norm- and criterion-referenced standardized test scores. Laptop-using students showed significantly higher achievement in nearly all measures after one year of participation in the program.

Coley, Cradler, and Engel (1997) find significant increases in student use of technology for drill and practice, but results are inconclusive regarding the effect of using technology on higher order skills such as cooperation, communication, and problem

solving. Other studies show that students using technology as a tool in learner-centered activities performed better on standardized tests, improved writing and independent thinking skills, and increased their ability to work independently (Kimble, 1999; Milken, 1998; Sivin-Kachala & Bialo, 2000; Viadero, 1997; Wenglinsky, 1998).

In a 1994 meta-analysis of 34 studies that investigates the effectiveness of the use of computer applications in improving academic achievement, students across all grade levels who received computer-based instruction saw academic improvement. A much larger meta-analysis of over 700 studies shows that students who engaged in innovative technology programs increased their scores on standardized tests. Students in the computer-based instruction program scored in the 64th percentile on achievement tests, compared to the 50th percentile for students in the control group (Schacter, 1999).

Fourth-grade students in Missouri who participated in a program using multimedia and computer technology consistently scored 10 to 13 points higher on assessments than students who did not use the technologies (McCabe & Skinner, 2003). In a meta-analysis of over 500 studies on the use of computer-assisted instruction, James Kulik (1994) finds that students utilizing the technology scored in the 64th percentile on standardized tests, while students who did not use the technology scored in the 50th percentile. In an analysis of over 200 studies, the U. S. Army Research Institute and Boise State University find that the use of technology had a significant effect on student achievement on test scores, in all subject areas and all age groups (Maryland State Board of Education, 1999).

Research has also identified a connection between the effective use of technology and the environment and culture of classrooms and schools. Software Information

Industry Association (SIIA) conducted a meta-analysis of 311 studies and determines that the use of technology had positive impact on student self-esteem, motivation to learn, and self-confidence (Sivin-Kachala & Bialo, 2000). Selected for inclusion in the meta-analysis based on their focus on teacher-student interaction in project-based classes, these schools experienced an improvement in creating motivational classroom environments. This analysis also shows that more advanced technology use had more significant impact on student learning. Simulations and virtual labs helped students with science learning, advanced software programs facilitated development of mathematics and problem-solving abilities, and use of multimedia technologies helped students learn social studies content.

Although it appears that technology has great potential to support instruction and improve overall student achievement as well as school environment and culture, there continues to be evidence that the potential impact of increasingly plentiful classroom technology is not being achieved (Means, 2010). Teacher integration of digital tools into instruction remains sporadic, with many technology resources remaining unused or used only for traditional teaching (Ertmer & Ottenbreit-Leftwich, 2010). The abundance and increasing sophistication of technology in schools has made little impact on the educational process (Hixon & Buckenmeyer, 2009). It is clear from the research that if technology in the classroom is to succeed in enhancing student learning and bringing about school change, there should be improvements in the ways in which instructional technology is being used by teachers and students.

How Technology Should Be Used for Learning

With so much research confirming the potential for positive impact of technology in teaching and learning, there continues to be evidence that technology is being used ineffectively in many schools, and is not reaching its full potential. The use of instructional technology in teacher-centered ways has been shown to have little impact on student learning, and many teachers continue to use technology to support their traditional teaching practices, rather than as a tool to bring more constructivist practices into the classroom (Cuban, 2001). According to the International Society for Technology in Education (2007) and the Partnership for 21st Century Skills (2011), the skills students need to become productive members of society include creativity and innovation, strong communication and collaboration skills, critical thinking and problem solving, multiple literacies, and technology expertise. There is considerable evidence that teachers are not ready to meet the challenge of facilitating those skills.

In the year 2000, almost two-thirds of teachers reported in a nationwide survey that they did not feel confident using technology (Web-Based Education Commission, 2000). By 2005, data from the Public School Technology Survey indicates that 46 states reported less than 20% of their teachers as technology novices (Swanson, 2006). While fewer teachers are categorized as technology novices, critics continue to point to the lack of technology use for instructional purposes (Doherty & Orlofsky, 2001; U. S. Department of Education National Center for Education Statistics (NCES), 2009; Zehr, 2001).

A survey by Education Week in 2001 shows that 71% of students polled said their teachers did not use technology to help them understand problems, and 86% said their

teachers used computers to demonstrate how to write papers (Doherty & Orlofsky, 2001). Learning Quest.com (2006) surveyed 44,690 teachers nationwide whose school districts had implemented technology-specific standards and professional development. They find that 48% of teachers reported only using technology for administrative tasks such as recording attendance, grading, or the use of multimedia for basic comprehension activities. Technology that is used as a tool to merely automate traditional practices limits the possibilities for enhanced learning (Burgess, 2002; U. S. Department of Education National Center for Education Statistics, 2010).

Teachers' beliefs may influence their use of technologies (Hermans, Tondeur, Van Braak, & Valcke, 2008; Sugar, 2002; Wen & Shih, 2008). The beliefs that may have impact on teacher participation and success in technology integration include teacher efficacy, beliefs about instructional practices, beliefs about the use of technology in teaching, and beliefs about students. There is considerable research about teacher beliefs about technology and the use of technology in teaching, but Kim, Kim, Lee, Spector and DeMeester (2013) suggest that more consideration should be given to teachers' fundamental beliefs about knowledge and how knowledge is acquired, to help them overcome barriers in teaching with technology. They find that teachers' fundamental belief about the source of knowledge and the concept of students finding their own knowledge is a factor that can have significant impact on teacher acceptance of technology integration.

The impact that technology use can have on student achievement seems to be more dependent on how the technology is used than on the technology itself (O'Hair & Reitzug, 2006; Otero, et al., 2005). According to O'Hair and Reitzug (2006), technology

should be used in schools in the same ways it is used in society, as a tool to increase productivity and efficiency, and as a way to gain knowledge. In the National Education Technology Plan of 2010 (NETP), the U. S. Department of Education's Office of Educational Technology states that students' lives are filled with technology that provides them full time access to information, making learning opportunities "limitless, borderless, and instantaneous," (Executive Summary, p. *x*) and it is the challenge of our education system to combine the learning sciences and technology to create engaging, relevant, and personalized learning experiences that reflect students' daily lives, as well as their futures. Using real world technology tools within learning opportunities that include solving real-world problems more effectively prepares productive members of a globally competitive workforce. The NETP proposes specific actions to help reach the goal of professional educators supported by technology that "connects them to data, content, resources, expertise, and learning experiences that enable and inspire more effective teaching for all learners" (U.S. Department of Education, 2010). Those actions include:

- Expand opportunities for educators to have access to technology-based content, resources, and tools where and when they need them.
- Leverage social networking technologies and platforms to create communities of practice that provide career-long personal learning opportunities for educators within and across schools, pre-service preparation and in-service educational institutions, and professional organizations.

- Use technology to provide all learners with online access to effective teaching and better learning opportunities and options in places where they are not otherwise available.
- Provide preservice and in-service educators with professional learning experiences powered by technology to increase their digital literacy and enable them to create compelling assignments for students that improve learning, assessment, and instructional practices.
- Develop a teaching force skilled in online instruction.

The NETP describes a gap in technology understanding that exists because many existing educators do not have the same understanding of and ease of use with technology that is part of everyday life for other professionals as well as the current generation of students. This lack of technology expertise is also present in many education leaders and policymakers. "This gap in technology understanding affects program and curriculum development, funding and purchase decisions about educational and information technology in schools, and preservice and in-service professional learning. Too often, this gap prevents technology from being used in ways that would improve instructional practices and learning outcomes" (NETP, 2010, Executive Summary, p. 48).

Many studies indicate that technology should be fully integrated into the curriculum in order to have the most impact on student learning. Technology use should be in the context of learner-centered activities, rather than simply developing technology skills that are used in more traditional, teacher-centered practice (Brush & Saye, 2009; Ertmer, 2005; Hew & Brush, 2007; Koehler & Mishra, 2008; Mishra & Koehler, 2006;

Mouza, 2011; Polly & Hannafin, 2011). In an analysis of the Apple Classrooms of Tomorrow project, Fisher, Dwyer and Yocam (1996) and Sandholtz, Ringstaff, and Dwyer, (1997) find that when students used computers as tools in authentic, student-centered learning activities, they routinely used higher order thinking skills far beyond what was expected for their grade level. Students were more likely to show initiative and independent thinking, attendance improved, and dropout rates declined. They exhibited an enhanced ability to work in collaborative groups to accomplish project tasks and create reports, and showed greater initiative, remaining on task for longer periods, even continuing work on classroom projects during lunch breaks and before and after school.

Creative and student-centered technology integration requires that teachers and students be well prepared and well supported in their efforts. Technology alone does not drive student performance or ensure they will acquire skills (Chaptal, 2002). Forgasz (2003) finds that students who used technology only for drill and practice scored lower on assessments than those who used the technology in more authentic ways, to enhance understanding of concepts. Sandholtz et al. (1997) determines that technology is most powerful when students use it as a tool to solve problems and develop concepts; when students use technology to gather, organize, and analyze information, and then develop those findings to solve problems or create products. Studies indicate that students learn more when teachers teach authentically; pursue a clear, shared purpose for all students' learning; engage in collaborative activities to achieve that purpose; and take collective responsibility for student learning (Newmann, et al., 1995).

Cradler, McNabb, Freeman, and Burchett (2002) examine a number of research and evaluation studies gathered by the Center for Applied Research in Educational Technology (CARET) and conclude that research is providing more clarity about how technology can be used effectively in school communities in ways that support and enhance academic performance. They specifically identify collaborative projects and formative feedback as key instructional strategies that are a part of effective technology integration. Students construct their own knowledge, solve problems, create products, and develop a deeper understanding of the content. This constructivist approach emphasizes teaching for understanding, requires frequent interaction among students and teachers, and encourages student self-direction (Solomon, Battistich, & Horn, 1996).

Kleiman (2009) discusses myths and realities about the use of technology in schools, and states that the key to successful integration of technology is not how much technology equipment is purchased, but how we define educational goals and visions, prepare and support teachers, and design technology-rich curricula. Rather than simply adding technology use to the classroom, there should be a change from teacher-centered to student-centered learning and a change of the teacher's role from provider of information to facilitator as students construct their own knowledge (U. S. Congress Office of Technology Assessment, 1995). Ringstaff and Kelley (2002) examine a number of major research findings related to the use of educational technology and the implications for getting the most out of classroom technology. The researchers identify a list of conditions that contribute to desirable outcomes in school technology projects:

- Technology as one piece of the puzzle – along with reform at the classroom, school, and district level

- Adequate and appropriate teacher training
- Changing teacher beliefs about learning and teaching
- Sufficient and accessible equipment
- Appropriate placement – classrooms vs. computer labs
- Long-term planning, with standards and goals for technology use developed by administrators and other stakeholders
- Technical and instructional support
- Technology integrated within the curricular framework

Ringstaff and Kelley (2002) also stress the need for (and absence of) valid, reliable, and cost-effective ways to assess "students' higher-order thinking skills, problem-solving ability, or capacity to locate, evaluate, and use information – skills that many researchers and teachers believe can be enhanced through technology use (p. 24).

The indication from much of the available research is that the many changes that occur when technology is brought into the classroom can present a tremendous challenge to teachers, administrators, and technology directors. The process is not a short-term one and requires careful planning, and the challenge is greater due to the existence of several serious barriers to successful technology integration.

Barriers to Successful Technology Integration

The literature brings to light several barriers that schools face in their efforts to bring authentic technology use into classrooms. One of the most frequently cited barriers, both in the literature and in my experience as a facilitator working with technology integration programs in public schools in Oklahoma, is the lack of prompt, knowledgeable technology and instructional training and support for teachers,

administrators, and students (Albirini, 2006; Groff & Mouza, 2008; Ozden, 2007; Sicilia, 2005; Toprakei, 2006).

Successful integration of technology requires quality technology training and technical support that has many dimensions, from routine maintenance to individualized instruction on integration of technology tools into curriculum. The International Society for Technology in Education (2009) identifies a set of conditions essential to effectively leverage technology for learning, including:

- A systemic plan for student learning through the use of information and communication technology
- Ongoing funding to support infrastructure, personnel, digital resources, and staff development
- Reliable access to current and emerging technologies for all students, teachers, staff, and school leaders
- Educators, support staff, and instructional leaders skilled in the effective use of technology resources
- Technology-related professional learning plans with dedicated time to practice and collaborate
- Consistent and reliable technical support, and policies, financial plans, accountability measures, and
- Incentive structures to support the use of technology and digital resources for learning.

School technology support organizations must address both the technical and the instructional needs of teachers and students, be directed by well-qualified technology

coordinators, and utilize as support personnel individuals who have the ability to bridge technical ability with classroom teaching expertise (British Educational Communications and Technology Agency (BECTA), 2004; International Society for Technology in Education, 2008; Means, 2010; Means & Olson, 1995; Ronnkvist, Dexter, & Anderson, 2000). Addressed first is technology support in terms of instructional needs and curriculum integration, followed by a review of existing literature on technical or operational support needs and issues.

Need for curriculum integration professional development and support. For successful implementation of classroom technology, there is a great need for ongoing quality professional development and day-to-day support that will enable teachers to make the best use of the technology resources they have available (An & Reigeluth, 2011; Bingimlas, 2009; Dexter, Anderson, & Ronnkvist, 2002; Granger, Morbey, Lotherington, Owston, & Wideman, 2002; Means, 1995). Integration of the technologies and making them a part of student learning requires rich and varied support, including instructional as well as technical support. In a survey of teacher technology use in foreign language education programs in colleges and universities, Green (2010) finds that support in the form of professional development that emphasizes helping teachers to seamlessly integrate the technology into their content was far more valuable to the respondents than basic "how-to-use" training, and was reported as more valuable than the acquisition of the latest technology equipment (Brunk, 2008).

Teacher development of technology knowledge is determined to be one of the most significant factors in the effective use of technology to increase student achievement. Specifically, teachers need to receive instruction on how to use the

available technology within their curriculum. Mishra and Koehler (2006, 2009) introduce the concept of technological, pedagogical, and content knowledge (TPACK) as a framework for professional development for technology integration, and argue that teachers should develop expertise in all three categories for successful technology integration. Thompson and Mishra (2007) specify seven different types of knowledge, essentially various combinations of the original three categories, which teachers need to achieve technology integration. Although a large body of writing has been published on the subject of the TPACK framework, the complexity of applying it to real-world schools has been challenging, and it seems little progress has been made in establishing a simple, precise definition of the seven knowledge categories, or developing a suitable way to measure it (Graham, 2011).

More recently, Ertmer and Brantley-Dias (2013) offer a critical review of TPACK, and address the need for a simpler construct that will allow educators to refocus on what teachers need to achieve technology-rich learning. According to Graham, Borup, and Smith (2012), "the TPACK framework adds a significant level of complexity to the already complex PCK framework by more than doubling the number of framework constructs (from three in PCK to seven in TPACK)" (p. 4). By referring back to earlier works on the need for pedagogical as well as technological knowledge, Ertmer and Brantley-Dias (2013) propose a new definition of TPACK: "teachers' knowledge of how to integrate content knowledge with appropriate pedagogical approaches, including those that use emerging technologies, to enable learners to master the subject matter at hand" (p. 106). The authors note that it may be more effective to shift the focus from

technology integration to technology-enabled learning (Ertmer & Ottenbreit-Leftwich, 2013; Sutherland, Eagle, & Joubert, 2012).

Becta (2004) and Webb and Cox (2004) maintain that technology-enabled pedagogical training for teachers, rather than simply training them to use the technology tools, is an important issue, and maintain that if teachers are to be convinced of the value of using technology in their teaching, training should focus on pedagogy. Researchers identify a number of factors must be addressed for teachers to successfully integrate technology into curriculum, including internal factors such as teacher pedagogical beliefs, confidence, and attitudes, and external factors that include school and classroom cultures and school and district policies (Ertmer, 1999, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Kim, et al., 2013).

Longitudinal research suggests that teacher support requirements change over time. In the beginning stages, the basic knowledge of how to use hardware and software is primary, but as teachers progress in technology integration, they need more assistance with project-based, interdisciplinary instruction and with student assessment strategies for project-based learning activities (Mouza, 2011). At sites participating in the Apple Classrooms of Tomorrow (ACOT) program, data indicate that as teachers began using technology for more sophisticated purposes, instructional support became as essential as technical support (Apple Computers, 1999).

Staples, Pugach and Himes (2005) study how different schools used similar resources to improve technology integration in their classrooms, and isolate several characteristics that affected each school's level of success. They find that the commitment to curriculum and basing technology integration decisions on instructional

goals was a critical step in technology integration. The most successful of the schools they studied had in place a formal structure for teacher leaders to assist and guide others in their efforts to integrate technology, and the group of teacher leaders worked closely with technology support personnel. For teacher leaders to succeed in providing valuable guidance to colleagues, they require time away from their own teaching responsibilities as well as strong administrative and peer support (Bingimlas, 2009; Peck, Lashley, Mullen, & Eldridge, 2011; U.S. Congress Office of Technology Assessment, 1995).

The effectiveness of peer support and teacher collaboration to achieve technology goals is an important element identified by Becker and Riel (2000). In a study of K-12 teachers and administrators at 21 grant recipient schools, Williams (2006) finds a positive correlation between teacher collaboration and technology integration in the teaching and learning process. Teachers increase their own learning through "interactions with other professionals who offer ideas and evidence of effective practices, provide feedback and suggestions for improvement, and give moral support essential to the improvement process" (Knapp, Copland, Ford, & Markholt, 2003, p. 15).

Other studies point to collaboration as an important factor in creating professional learning communities and reducing isolation (Dufour & Eaker, 1998), and there is evidence of improved student achievement in collaborative school environments (Lee & Smith, 1996; Newmann & Wehlage, 1995; Schmoker, 1999, Zhao & Bryant, 2006). The effectiveness of peer support and teacher collaboration is an important element identified by Ebersole and Vorndam in their 2002 case study of university faculty members and their perceived barriers to technology integration success. Zhao and Bryant, in their 2006 examination of teacher technology integration following mandated

technology training, find that ongoing technical and technology curriculum integration support is necessary following initial training, in order for teachers to reach the desired level of success. They find the impact that mentoring can have on teacher comfort levels with technology is great, allowing teachers to expand technology integration skills based on their current skill levels, providing ideas for integrating technology with state curriculum standards.

Professional development for teachers seeking to integrate technology should be focused on curriculum, provide individualized training, and include opportunities for teachers to observe technology-rich classrooms in action (Bingimlas, 2009; Hoffman, 1997; Mouza, 2005; Dexter et al., 2002; Ronnkvist et al., 2000). Means and Olson (1995) speak of a "vision for technology-supported reform-oriented classrooms, one in which student groups work on long-term, multidisciplinary projects involving challenging content that is interesting and important to them with the support of technology tools for collecting, analyzing, displaying, and communicating information." To make this vision a reality, teachers require hands-on training and quality ongoing support in developing instructional materials, assessing student performance, and expanding their own content knowledge (An & Reigeluth, 2011; Peck et al., 2011; Ronnkvist et al., 2000; Wetzel, 2006, Zhao & Bryant, 2006).

In an examination of data gathered by the Teaching, Learning and Computing (TLC) survey (1998) along with the CEO Forum's (2001) professional development recommendations, Ronnkvist, et al. (2000) develop a framework for defining the various elements and characteristics of high-quality technology support. The survey utilized a national sample of principals, technology coordinators, and teachers in U.S. elementary

and secondary schools. Respondents were asked about the availability of technology support, technology support staffing, the presence or absence of one-on-one help, and professional development. The researchers conclude that teachers' use of technology is positively related to support, and that high-quality technology support is comprehensive, includes ongoing technical as well as instructional support, and focuses on instruction and integration.

In a series of case studies where teachers, administrators, teacher-librarians, and education technology experts from twelve Canadian schools were interviewed concerning their experiences in the use of technology, participants indicated a preference for learning the use of instructional technology in more informal ways. They indicate learning from collaboration with peers and/or students, on-the-job discussions and conversations with family and friends as being more useful than structured workshop training sessions (Granger et al., 2002). Other studies find that mentoring may help to overcome many of the barriers that teachers face in technology integration efforts (Bullock, 2004; Franklin, Turner, Kariuki, & Doran, 2001; Gallagher, 2000; Polselli, 2002; Swan & Dixon, 2006; Ward, West, & Isaak, 2002).

Franklin, et al. (2001) find that teachers who learned technology integration with a mentor more easily overcame typical barriers of time, troubleshooting, and actual classroom technology use. May (2000) finds that when one teacher serves as a mentor in the process of technology training, there is a three times greater gain on teacher evaluation scores versus traditionally trained teachers. May also finds that teachers reported that mentors promote confidence in using technology, increased their ability to work through technical problems, and increased the desire to continue to integrate

technology. Davis (2002) evaluated effectiveness of one-on-one follow-up support and mentoring with Georgia Technology Integration trained teachers, and finds that participants who receive the personalized follow-up assistance experienced higher levels of technology integration success, while teachers who did not receive the one-on-one support were unable to incorporate lessons they received in initial training. Poselli (2002) finds that 139 teachers who received mentoring support reported increased comfort levels, higher self-perceived skills, and increases in the number of times they integrated technology into their practice. Kopcha (2010) proposes a systems-based model for technology integration that uses mentoring as the primary approach to professional development, and includes four stages, with a mentor guiding the learning teacher through initial setup, teacher preparation, curricular reform, and community of practice. At the end of the cycle, a formative evaluation allows mentor and teacher teams to revise goals and continue working together until the teacher is comfortable with expanding their technology integration efforts.

The effectiveness of just-in-time, collaborative learning is also supported in the work of Burns and Dimock (2007) where the researchers identify the "*5J*" approach to technology professional development: *Job-related* – focused on instructional needs; *just enough* – emphasizing increased comfort with technology rather than proficiency; *just in time* – providing teachers with skills as they need them, and focused on using only the tools they have available; *just in case* – encouraging teachers to have a back-up plan in case of technology problems or equipment failure; and *just try it* – applying just enough pressure and support to encourage teachers to get started using the technology.

There is substantial support for the need to provide quality technology-specific professional development for teachers, and 45 states require technology standards for teachers. The National Council for Accreditation of Teachers (2014) established technology as an area of accreditation, however only 45% of the nation's teacher preparation programs are accredited by NCATE. In 2006, only 21 states required technology coursework or assessment for initial teacher licensure, and only nine states required technology professional development or assessment for recertification (Swanson, 2006). Zhao and Bryant (2006) find that low rates of technology integration, even after technology training, may be attributed to the lack of ongoing technical and curriculum integration support after the initial training.

Recent studies paint a more encouraging picture. A report released in 2013 by the American Association of Colleges for Teacher Education, based on a 2012 survey of over 800 higher education institutions, shows that 98 percent of teacher education programs prepare students to use technology for instruction, and 62 percent include a technology requirement for graduation or program completion. The National Center for Educational Statistics 2008 survey of 2,512 Title IV degree-granting four-year institutions shows that integrating technology into instruction is taught in all or some teacher education programs at all of the four-year institutions surveyed. All of the institutions having teacher education programs for initial licensure report teaching the use of Internet resources and communication tools. Ninety-nine percent confirm they teach development of curriculum plans using technology to address content standards, 97 percent teach the use of content-specific software tools, 95 percent include

multimedia content, and 90 percent use technology to access or manipulate data to guide instruction.

Teacher acceptance of and interest in the use of technology is also on the increase. A 2012 survey of over 500 kindergarten through eighth grade teachers finds that nearly 70% of teachers agree that using digital games increases motivation and engagement with content and curriculum (Joan Ganz Cooney Center, 2012). A Bill & Melinda Gates Foundation survey of 400 teachers finds that teachers believe technology tools can help motivate and engage students in more in-depth learning (2012), and results from the PBS LearningMedia survey of over 500 teachers finds that 74% of teachers surveyed believe technology tools have the potential to motivate students to learn (2013). The PBS LearningMedia survey finds that more than 68% of teachers feel that they need more instructional technology, with over 75% expressing that need in lower-income schools.

As the quantity and complexity of available classroom technology increases, there is growing need for more ongoing technology professional development for teachers. According to the International Society for Technology in Education (ISTE) Technology Support Index, standards for teachers include the need to implement multiple types of technologies, including web-based and media-based tools, to create student centered classrooms (ISTE, 2009). Professional development is the number one technology priority in 32 out of 48 states that responded to the Public School Technology Survey (Swanson, 2006); it appears that more in-depth and ongoing technology-centered professional development is necessary for teachers to succeed.

For technology integration to reach its potential, a more basic concern, that of supporting the daily operation of the technology hardware and software – keeping the equipment running – is one that many schools and districts find particularly challenging. Unless the technology is easily accessible, reliable, and consistent in performance, teachers are likely to be discouraged from embracing it and making it a part of their practice (Peck et al., 2011).

Need for timely and reliable technical support – making it work. As teachers integrate the use of instructional technology, they are in many cases being called upon to develop a new and complex set of skills and problem-solving abilities; not only must they possess content knowledge, they must also learn to operate technology, use it as a pedagogical tool for both instruction and assessment, and troubleshoot problems when they arise. For many teachers, this requires a great deal of training and support (An & Reigeluth, 2011; Dexter et al., 2002; International Society for Technology in Education, 2008; Peck et al., 2011; Ronnkvist et al., 2000).

As the use of instructional technology grows, the existence and effectiveness of quality prompt technical support becomes a major concern. Researchers suggest that teachers and students should have the benefit of full-time, on-site technical support just as technology users experience in the business community. If teachers are to develop constructivist uses for technology, they need a supportive, consistent environment. Technology support must be of high quality, readily available, and on-site (Coppola, 2000; Green, 2010; ISTE, 2009; Peck et al., 2011). In the National Education Technology Plan (2010), the U.S. Department of Education Office of Educational Technology defines school technology infrastructure as including not only the hardware,

software, and network devices, but also interdisciplinary teams of professionals responsible for development, support, maintenance, and management of technology resources.

On-site technology support is extremely limited in many schools. The percentage of schools with full-time, non-teaching technical support personnel did not change from 1989 to 1992, a time when technology acquisition and use was rapidly increasing (Fulton & Sibley, 2003). In 1992, only 6% of elementary schools and 3% of secondary schools had full-time technology support available. Schools spent less than 15% of technology budgets on training and support, with the remainder being used for purchasing hardware and software (U.S. Department of Education, National Center for Education Statistics, 2009, 2000; U.S. Congress, Office of Technology Assessment, 1995; Wetzel, 1999).

Several studies address the continuing problem of maintaining technology equipment in working order, especially as equipment ages and software advances push existing hardware to its limit. Unreliable equipment, inconsistencies in availability, connectivity, and compatibility, lack of timely repair service, and inadequate support personnel (both in numbers and in expertise) are cited as having considerable negative effect on technology integration efforts (Green, 2010; Means, & Olson, 1995; Norris, Sullivan, Poirot & Soloway, 2003; Staples et al., 2005). The Web-Based Education Commission (2003) estimates that technology coordinators average only three to four minutes per teacher per week to help them with technology integration. It also reports that fixing a technology problem required from 14 hours to seven days, with an average response time of two days.

Many teachers lack the expertise to troubleshoot problems when they occur, and valuable class time can be lost as teachers attempt to fix problems, or wait for a technician that may be responsible for supporting an entire district (Peck et al., 2011). Teachers are discouraged by equipment failures, especially during the early stages of implementation, when systems are subject to breakdowns and glitches that require immediate attention (Becta, 2004; Coppola, 2000; Hoffman, 1997; Means, 1995). "Technology instability saps teachers' energy from the most important work at hand: creating high quality instruction. As professionals, their expertise is best employed when they are free to teach" (Coppola, 2000). Research confirms that the frequency, variety, and progressive use of technology is positively correlated with the availability of quality technology support that includes elements as general as access to equipment and as specific as individualized training (Dexter, et al., 2002).

In case studies that examine how the level of technology support affected teachers' success in developing and implementing technology-rich lesson activities, the lack of timely answers to questions, long waits for repairs, and unreliable infrastructures are often mentioned as obstacles. Teachers reported that if they could not depend on the technology to work when they needed it, they would not use it. In an environment where resistance to change and reluctance to use new teaching strategies is widespread, the absence of quality technology support proves to be a major stumbling block (Becta, 2004; Coppola, 2000; Dexter, et al., 2002; Ebersole & Vorndam, 2002; Granger et al., 2002; Kleiman, 2009).

Results from many schools and districts also support the fact that critical elements of quality technology support are best achieved through specific training qualifications,

and that support personnel should be given the opportunity as well as the responsibility to acquire training that will facilitate high quality support (Dexter et al., 2002; Coppola, 2000; Peck et al., 2011). School technology support has traditionally been divided into two categories: working with equipment and working with people. By the year 2000, technology support had broadened to encompass a much wider range of resources, and training and support needs greatly expanded. The instructional technology field is "a quicksilver environment, changing constantly and dramatically" (Carter, 2000). No longer are technology support personnel being successful at "wearing many hats" – especially when those support technicians also have classroom teaching responsibilities.

In a 2011 report of a survey conducted by SchoolDude.com and the Consortium for School Networking (CoSN), hundreds of IT professionals are asked about their technology departments, including staffing, asset management and funding. Their responses reveal that educational technology continues to suffer severe, if not overwhelming, challenges, including budget constraints, lack of adequate staff for the amount of technology to be supported, and rapidly changing technologies. Seventy-eight percent of respondents indicate the need for more instructional technology staff, and 74 percent need more technicians. As in the prior three years of this survey, more than 70 percent indicate they are inadequately staffed to integrate technology into classrooms. The ratio of students to support technicians was 1,905:1, and mean ratio of students to total technical support staff was 532:1. Compared to non-education industries, school technology support personnel are responsible for five times as many technology users.

For many schools and districts, technology support positions have evolved from other vital functions: business/technology teachers, library-media specialists, or

administrators have taken on support responsibilities in addition to their existing duties. Many individuals who currently hold technology-related positions do not have a technology background, or any formal training or certifications. Classroom teachers, school secretaries, and even parent volunteers have been pressed into service as "technical support" by schools with no budget provisions for hiring qualified technicians (Norris, et al., 2003).

District-level support programs are becoming more prevalent, and some schools are benefitting from district-funded, building-level technology positions. Other schools are attempting to manage the problem by assigning classroom teachers the added responsibility of providing technology support to the rest of the staff and providing compensation in the form of stipends. Teams of teacher leaders are taking on the often-uncompensated function of assisting their peers with technology issues (Staples, et al., 2005). Other innovations that are being tried include student technology programs, outsource contracts, and leasing of administrative services (Carter, 2000). The U.S. Department of Education (2010) includes as part of its long-range plan working with districts, states, and the private sector to develop effective technology support models to enable students and teachers to take full advantage of the vast learning opportunities available. The plan includes improved security systems, more intelligent filtering systems, and personnel to provide support for school-, student-, and educator-owned devices used for learning.

Summary

Technology is increasingly at the core of daily life, and should be leveraged to provide powerful, engaging learning experiences, as well as resources for more

meaningful assessments that measure student achievement in more authentic ways (National Education Technology Plan, 2010). Nationwide, schools are increasing spending for more sophisticated technologies and more staffing to support those technologies. The Federal Communications Commission's Universal Service Fund, better known as eRate, has committed more than $30 billion to offset costs of technology products and services since it began in 1997. For the 2010-2011 school year, $2.29 billion was budgeted, which continues to have significant impact on the availability of technology resources to more and more schools (Harrington, 2011; Lee & Lind, 2010).

Many teachers and students have access to technology both at school and at home, and the use of technology is becoming more a part of instruction, yet in many cases the ways in which technology is used is preventing schools from reaching the potential impact on student learning and school culture. While the literature shows mixed impact on student achievement, researchers have generally found that the appropriate use of technology can have positive effects.

Many studies show that in order for teachers to use technology successfully, a system of ongoing support, both pedagogical and technical support, should be in place. A number of researchers address the issue of access to technology and the need for technology professional development, yet there is much less data available concerning the impact that the system of ongoing pedagogical and technical support can have on successful technology integration and school change. This study focuses on the factors that contribute to or undermine the success of teachers, administrators, and technology directors in implementing instructional technologies, and specifically on the effects of

technology training and support on that success. The following chapter addresses the methodology used to answer the research question.

CHAPTER THREE

Method

Introduction

This study addresses a frequently reported barrier to successful integration of technology into classrooms -- the need for effective technology training and support. It examines the experiences of teachers, administrators, and technology directors engaged in a successful technology implementation program, identifying characteristics of technology training and support that seem to contribute to the success of schools in their efforts to make technology an integral part of their teaching. The data collected and analyzed in this study answers the following research question:

> What structures and conditions for instructional technology support do teachers, school leaders, and technology directors identify as being critical to the success of their classroom technology integration efforts?

Because my goal is to acquire a greater understanding of the experiences, processes, and issues that schools encounter when they embark on a technology implementation journey, this question is best explored through the collection, in-depth analysis, and rich description of data in a qualitative case study (Merriam, 2009). Examining the experiences of a successful technology integration program through the lens of the existing literature along with the described experiences of the participants will provide insights and understandings that may be used "to affect and perhaps even improve practice" (Merriam, 2009, p. 51).

Design of the Study

A qualitative case study, like other forms of qualitative research, involves the search for meaning where the researcher is primarily responsible for collecting and analyzing data. The process is inductive, and the end product is richly descriptive (Merriam, 2009). Case studies are more specifically defined as in-depth analysis and description of a bounded system, a single entity or unit (Merriam, 1998; Smith, 1978; Stake, 1995; Yin, 2009). Creswell (2007) provides a more detailed definition of a qualitative case study which includes the study of a bounded system over time through the use of detailed, in-depth data collection from multiple sources, with the end product being a case description and case-based themes.

In seeking to answer the research question, the characteristics of qualitative case studies offer valuable insight. According to Merriam (2009), qualitative case studies may be characterized as particularistic (focusing on a particular program or phenomenon), descriptive (providing an end product of rich description of the phenomenon being studied, and heuristic (enhancing the reader's understanding of the phenomenon under study). These features of qualitative case study can provide valuable insights into relationships and variables, and provide greater understanding of experiences (Stake, 2007). This case study can be further defined as observational, in that data gathering techniques include participant observation supplemented with interviews and review of documents, and the fact that it is focused on a specific organization (Bogdan & Biklen, 2007). Analysis of the experiences of teachers, administrators, and technology directors engaged in technology implementation in a technology-rich school help to identify

characteristics and structures of technology training and support that seem to contribute to a school's success.

Sample Selection

The sampling strategy should fit the purpose of the study, the questions that are being asked, and the resources that are available. The power of purposeful sampling lies in selecting information-rich cases (Patton, 2002). Merriam (2009) defines purposeful sampling as being "based on the assumption that the investigator wants to discover, understand, and gain insight and therefore must select a sample from which the most can be learned" (p. 77). Two levels of sampling are usually needed in case study research; first the selection of the "case" or bounded system, and within that case the selection of individuals, activities, processes, or documents to be studied (Merriam, 2009).

The Setting

The case selected for this study, Pleasant Valley School is a single-school district in rural Oklahoma, with approximately 500 students enrolled, over 62 percent Native American ethnicity, and over 83 percent of the students in poverty as represented by the number of students qualifying for the Free and Reduced Lunch Program. The 2012 school report card shows that Pleasant Valley School received an overall grade of B. Thirty-three percent of the overall grade is based on the Oklahoma School Testing Program assessments in grades three through 12. The school's lowest area of student achievement was in reading, with a letter grade of D. Student growth represents seventeen percent of the overall grade of B, which is based on annual student learning gains as measured by annual standardized assessments in reading and mathematics in grades three through eight, and Algebra I and English II end-of-instruction tests. The

final 33 percent of the overall grade is attributed to whole school performance, based on attendance, dropout rates, and parent and community engagement. (Oklahoma State Department of Education 2012 Student Report Card).

Although the majority of students at Pleasant Valley School come from poverty, one does not get that impression when you enter the building. The facilities are relatively modern, well designed, and kept clean and in good repair. The atmosphere at the school is much like a family, where most teachers, students, and many of the parents know each other and work together for the good of the school. Although Pleasant Valley is just a few miles from a town with over 16,000 in population, the rural location and the fact that there is only one school in the district creates an atmosphere of a small rural community. Students who come to the school are generally well dressed and well groomed, and there is a real sense of camaraderie between students, teachers, and administrators.

Pleasant Valley School, at the end of its technology grant implement year, showed significant growth and was evaluated as high performing, based on the granting agency's established assessment criteria and performance factors. I was an active participant as the school transformed from very traditional, with very little instructional technology and no structure for sharing leadership or teacher collaboration, to a technology-rich, high-functioning professional learning community, and was very interested in learning about their progress since the grant implementation, and seeing how (or if) the structures put in place during the 2009-2010 school year were sustained.

Data Collection

According to Yin (2009), "a major strength of case study data collection is the opportunity to use many different sources of evidence. Furthermore, the need to use

multiple sources of evidence far exceeds that in other research methods" (p. 114). Triangulation was derived from navigation science, and has been successfully applied to social science research (Richards, 2005; Rossman & Wilson, 1994). Triangulation is defined as using three sources of data to "corroborate, elaborate, or illuminate the research in question (Marshall & Rossman, 2006). It is not about arriving at "truth", but about developing multiple perspectives of the phenomenon being studied. This case study will include examination of data from interviews, direct observations, and documents to ensure that the findings are strong and grounded.

Interviews. Much of qualitative data is collected through interviews, which deMarrais (2004) defines as "a process in which a researcher and participant engage in a conversation focused on questions related to a research study" (p. 55). Interviewing a participant in a study provides data that we cannot observe, or about past events that we cannot recreate (Merriam, 2009). Interviews may be highly structured, where the questions are an oral form of a written survey; semi-structured, where the process is less structured but follow a predetermined guide; and unstructured or informal, using open-ended questions with flexibility more associated with a conversation (Merriam, 2009). In-depth interviews allow the researcher to ask participants about facts as well as opinions, or to solicit ideas or suggestions of insights into the topic being discussed (Yin, 2009).

The second level of sampling for this study, selection of the individuals for interviews, was also purposeful, in that the objective was to learn from the experiences of administrator and the technology director, along with teachers who use technology extensively and teachers who do not use technology or use it in more limited ways. The superintendent and technology director recommended two teachers in each of those

categories for interview, to best achieve the goal of learning from both viewpoints. Interviews were in person, one-on-one, in-depth, and semi-structured, and provided opportunities for flexible, exploratory questions with opportunities for follow-up questions. There was ample opportunity to follow up and fully explore their experiences and ideas. Interviews were digitally recorded (audio only), transcribed and coded, then analyzed for emerging themes.

Direct observations. According to Merriam (2009), qualitative researchers may use observations for a number of reasons. As an outsider, an observer may notice things that have become routine and go unnoticed by the participants, and may lead to greater understanding. Observations may also be used "to triangulate emerging findings; that is, they are used in conjunction with interviewing and document analysis to substantiate the findings" (Merriam, 2009, p. 119). Observations may also be used to provide reference points for subsequent interviews; the researcher may observe incidents that the interview subjects are hesitant to discuss. Yin (2009) suggests that observations of the phenomenon being studied are invaluable for understanding the subject matter, and can add new dimensions to the context and the phenomenon. For this case study, I observed technology use in multiple classrooms, along with teacher participation in technology-centered professional development activities. I also observed the technology director during her work supporting teachers in classrooms. Observations took place during the technology grant implementation year as well as the study year. As a function of my work with the school during the grant implementation, I collected field notes and written reflections which are included in the data.

Documents. Documents are a good source of data for the qualitative researcher. They may be easily accessible and contain information that would take the researcher much time and effort to gather otherwise (Merriam, 2009). The most important use of documents in case studies is to corroborate and augment evidence from other sources. Documents can play a valuable explicit role in data collection when doing case studies, yet it is important for the researcher to understand that documents were created for a purpose other than the research study at hand, and therefore must be viewed objectively and critically (Yin, 2009). According to Merriam (2009), documents can "furnish descriptive information, verify emerging hypotheses, advance new categories and hypotheses, offer historical understanding, track change and development" (p. 155).

Documents that were analyzed in the course of this case study include both historical and current documents. Historical documents include the school's grant application, action plans, professional development plans, professional development teacher evaluations, technology integration teacher survey results, staff as a learning community survey results, site visit reports, evaluations and assessments of the grant implementation, field notes and reflections from school technology training, school documents including technology training and support records, teacher support surveys, and technology budget information. All of the historical documents were collected during and immediately after the school's grant implementation year. Current documents include field notes and reflections from recent school visits, notes from conversations with teachers, administrators, parents, and students, school demographic data, and the school report card. Combined with the examination of the other sources of data, these

documents add detail, dimension, and insight into technology training and support experiences and issues at the school.

Data Analysis

Data analysis is the process of finding meaning or making sense from the data, and includes consolidating, reducing, and interpreting interview responses, field notes from observations, and notes from documents that the researcher has examined (Merriam, 2009, Yin, 2009). Yin (2009) suggests that the reliability of a case study may be increased if the data to be used is formally organized so that it may be reviewed independently of the researcher's narrative and reports. He recommends the database contain notes made by the researcher during the course of observations and interviews, copies of documents included in the study, and narratives that are not included in the final case study report. Merriam (2009) describes qualitative data analysis as inductive and comparative, and recommends the constant comparative method of data analysis, a concept first published by Glaser and Strauss (1967), which has been widely used in qualitative research.

Qualitative design is emergent, and data collection and analysis should be done simultaneously. The examination of data may reveal the need for additional or redirected investigation and follow-up interview questions. For this case study, the data analysis began with examination of the first interview transcripts, sets of field notes, and the document collected, and continued throughout the data collection process. Each of the three sources of data were annotated with comments, observations and questions to identify units of data that are relevant to answering the research question, a process that Merriam (2009) calls *open coding*. Units of open coded data that seemed to go together

were then grouped in a process known as *axial coding* (Corbin & Strauss, 2007) or *analytical coding* (Richards, 2005).

According to Merriam, 2009, the categories that emerge during data analysis should be responsive to the purpose of the research, should be exhaustive (every unit of data should fit into one of the categories), should be mutually exclusive, should be sensitizing (the reader should be able to understand the nature of the categories), and be conceptually congruent, or on the same level of abstraction. Categories developed during the early stages of analysis may be combined, revised, or renamed, depending on the nature of the themes that emerge from the data. In the analysis of data for this case study, the initial nine themes were reduced and combined to four main themes, using guidelines suggested by Guba and Lincoln (1981), specifically the frequency with which an idea, statement, or fact appears across the data. Through the analysis of the themes that emerge from the data, I interpreted the meaning and developed a narrative account of the findings.

The process of triangulation of data was continuous during the collection and analysis of data, and a cross-set comparison (Anfara, Brown, & Mangione, 2001) of the three data sources determined that the different sources supported each other, and worked together to answer the research question. This *methodical triangulation* adds another level of analysis; since narrative field notes are written from the researcher's perspective and are more likely to be subjective, it is necessary to seek confirmation of findings from more objective data sources (Stake, 1995).

Validity (Credibility) and Reliability (Trustworthiness)

For a study to have effect on the theory or practice of a field, it must be conducted rigorously, and should provide insights and conclusions that readers, practitioners, and other researchers find believable and logical (Merriam, 2009). Researchers, as well as readers, must have confidence in the way the study is conducted, and in the results that are derived. Lincoln and Guba (2000) ask whether a study's findings are "sufficiently authentic…that I may trust myself in acting on their implications? More to the point, would I feel sufficiently secure about these findings to construct social policy or legislation based on them (p. 178)? " Validity and reliability issues can be addressed by the social science researcher through careful design of the study, as well as the methods by which data are collected, analyzed, and interpreted, and the way findings are presented (Merriam, 2009). The qualitative study must include sufficient detail to show that the researcher's conclusions "make sense" (Firestone, 1987, p. 19).

Validity of the findings in a qualitative case study can be assessed both internally and externally. Internal validity determines the level of congruence between the findings of inquiry and reality. Merriam (2009) describes a number of strategies that can be used to increase the credibility of findings. Triangulation refers to using more than one source of data, and comparing and crosschecking the different data types to identify areas of commonality or areas of difference. Member checks or respondent validation involves obtaining feedback from interview participants to rule out misinterpretation of the meaning of what participants say or do. Maxwell (2005) adds that respondent validation is another way to identify researcher biases and misunderstandings. I employed

respondent validation by allowing participants to review transcripts of their interviews prior to my proceeding with the data analysis.

Another strategy for ensuring validity is adequate engagement in data collection: the data and emerging findings must appear saturated – data are collected until no new information is being discovered. Associated closely with adequate time in data collection is purposefully looking for variation in the understanding – attempting to identify data that support alternate explanations (Patton, 2002). This strategy is also known as negative or discrepant case analysis. Yin (2009) suggests, "if the quest for contrary findings can produce documentable rebuttals, the likelihood of bias will have been reduced" (p. 73).

Researcher's position, or reflexivity, is defined as "the process of reflecting critically on the self as researcher, the 'human as instrument'" (Lincoln & Guba, 2000, p. 183). Researchers should explain their biases and assumptions regarding the subject of the study, to provide the reader deeper understanding of how the researcher arrived at the interpretation of the findings (Merriam, 2009). Although I was actively involved in providing professional development and technology integration support at the subject school in the course of my association with the grant program, details of my work there are included in the report of results, and I exercised special care to ensure that personal or professional biases do not color or influence my interpretation of the data. My belief is that the school is best served through a research process that remains objective throughout data collection, analysis, and interpretation, and provides school leaders with data that is both valid and reliable, to be used to better accomplish their mission. As a professional development provider working with teachers and administrators during the grant implementation year, I developed a unique perspective, as the school transformed

from highly traditional, teacher-centered learning with little or no technology in the classrooms, to a fully functioning professional learning community, technology rich and highly collaborative, with genuine shared leadership and authentic teaching and learning as the norm. Prior to beginning this study, I reviewed all existing documentation and my recollections of the grant year, and listed the issues and impressions based on my previous experience with the school, in an attempt to bracket and reduce the likelihood that these experiences might influence the findings or my interpretation of the findings in this study.

A final strategy for insuring internal validity is peer examination or peer review. Review can be conducted by a colleague either familiar with the topic being studied, or one new to the subject, and involves asking a colleague to scan the raw data and assess whether the findings are based in fact (Merriam, 2009). Two colleagues who are not connected with the school reviewed the study to assist in assessing plausibility of the findings.

External validity refers to the ability to generalize the findings, to apply them to other situations. Although a qualitative study cannot be generalized in the statistical sense, there is still much that can be learned that may apply to other situations. Lincoln and Guba (1985) propose the idea of transferability, where "the burden of proof lies less with the original investigator than with the person seeking to make an application elsewhere. The original inquirer cannot know the sites to which transferability might be sought, but the appliers can and do." The researcher should include "sufficient descriptive data" to make transferability possible (p. 298). The efforts to ensure appropriate levels of internal and external validity in this study include triangulation of

multiple data sources, member checking, the inclusion of rich, thick descriptions, and dedicating adequate time to conducting direct observations and in-depth interviews.

Summary

This study employs the features of qualitative case study to focus on understanding the experiences of the individuals interviewed and observed, as well as the school as a whole. Combining, comparing, and correlating data gathered from interviews, direct observations, and documents generated answers to the research question, providing in-depth understanding of the structures, conditions, and practices at Pleasant Valley School that contribute to or detract from technology integration success. Chapter Four presents the findings in detail, and tells the story of the experiences of the school administrator, the technology director, and teachers in their efforts to implement instructional technologies.

CHAPTER FOUR

Results

Introduction

As earlier noted, the purpose of this study is to examine the experiences of teachers, administrators, and a technology director engaged in instructional technology implementation program in a technology-rich school, in an effort to identify characteristics, structures, and practices of technology training and support that the participants believe contribute to the successful integration of technology into curriculum. The study addresses a gap in existing literature concerning the importance of the role of technology-specific training and support in the use of classroom technologies. Ideally, the findings of this study provide insight into the connections between support and technology integration success, along with more specific processes, structures, and policies that participants in this study found valuable to their efforts.

The purposefully selected school in this study is evaluated as high performing according to technology grant performance factors. The granting agency's assessment criteria classify the school as experiencing significant growth during the grant implementation year, and my own observations and interactions with an administrator, teachers, the technology director, and students confirm the school's emergence as a technology-rich, highly collaborative learning community. My role in the school during the grant implementation year was that of professional development facilitator, which involved working with teachers and administrators one full day per month during the school year. Professional development sessions were technology-centered, including assisting teachers in development of technology-based lesson activities, working together

in either grade-level or cross-curricular projects, and working with teachers in classrooms as they learned to present and assess technology-rich lessons.

As an active participant in the school's change from very traditional, with very little instructional technology and no structure for sharing leadership or teacher collaboration to a technology-rich, high-functioning professional learning community, I looked forward to learning about their progress since the grant implementation, and seeing how the structures put in place during the 2009-2010 school year had been sustained. For anonymity, the school is referred to as Pleasant Valley School. Individuals who participated through in-depth interviews and classroom observations include the superintendent, the technology director, and four teachers who are referred to as High-Tech Teacher 1, and High-Tech Teacher 2, both extensive technology users, and Low-Tech Teacher 1 and Low-Tech Teacher 2, limited users of technology. The superintendent is new to the school, and replaced the individual who held the position during the grant year and had participated in the yearlong development program for school leaders.

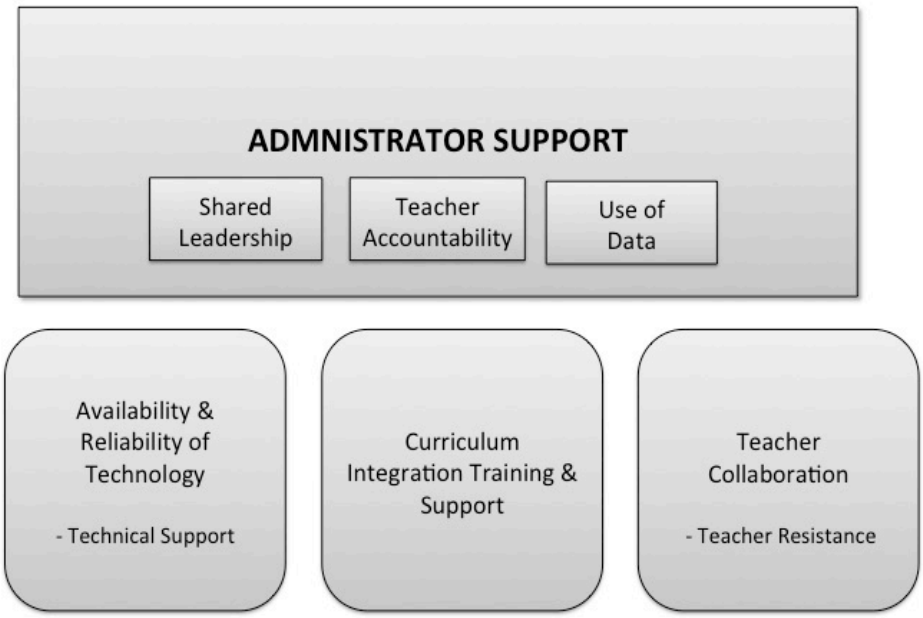
This chapter presents data collected through in-depth, semi-structured interviews with teachers, school administrators, and the technology director, analysis of classroom observations and field notes, and examination of both historical and current documents. Teachers were purposefully selected for interview based on their levels of technology use in their instruction. Open and analytical coding of interview transcripts, field notes, and documents followed by cross-set comparison resulted in the emergence of four main themes that work together to answer the following research question: What structures and conditions for instructional technology support do teachers, school leaders, and

technology directors identify as being critical to the success of their classroom technology integration efforts? The themes and subthemes that emerge from the examination of the data to answer this query are:

- Support of administrators
    - Shared leadership
    - Teacher accountability
    - Use of data to guide instruction
- Curriculum integration training and support
- Teacher collaboration
    - Teacher resistance
- Availability and reliability of technology
    - Technical support

The following model illustrates the themes and subthemes that emerged from the data and their relationships to each other. In examining the three sources of data collected during the study, the theme of *administrator support* clearly presented as all encompassing, and is seen by the interview participants as having considerable effect on the remaining three themes, which appear in the data as relatively equal in emphasis and frequency.

Figure 1: Themes and subthemes



Theme One: Support of Administrators

There are a number of studies that identify the role of school leaders as critical to the successful development of technology-rich, curriculum-integrated learning experiences for students. "Leadership is probably the single most important factor affecting the successful integration of technology into schools" (Byrom & Bingham, 2001). Anderson and Dexter (2005) validate the importance of leadership in technology integration efforts in their study of data from over 800 schools, examining the effects of leadership on technology integration outcomes. School leaders should facilitate and model the use of technology in ways that support higher-level thinking, decision-making, and problem solving (ISTE, 2007). In its most recent publication of ISTE Standards for Administrators (ISTE, 2009), ISTE identifies standards for evaluating the skills and

knowledge school administrators and leaders need to support digital age learning. These standards include:

- Visionary leadership for development and implementation of a shared vision for technology integration
- The creation and promotion of a sustainable digital-age learning culture
- Promotion of an environment of professional learning and innovation that empowers educators to integrate technologies and digital resources
- Continuous improvement through effective use of technology resources, and
- Modeling and facilitating the understanding of social, ethical, and legal issues and responsibilities in an evolving digital culture.

School leaders are needed who can act as change agents to promote the successful implementation of technology, and they must incorporate multiple perspectives and the values of others to create a shared vision for the future (Moos, Krejsler, & Kofod, 2008).

The importance of the role of school administrators and leaders is echoed throughout the data collected in this study. The effective support of leadership was the most prevalent theme across the three sets of data, and was the single most discussed issue in teacher and technology director interviews, in conversations with teachers, and in the field notes from observations. The school's application for the grant referenced the importance of active participation by administrators in their plan to implement the grant, and included plans for providing extensive resources, time, and assistance for teachers to develop their technology use skills.

All four teachers and the technology director cited the need for greater administrative support for their technology integration efforts. In the technology director's words:

> We have funding, we have the resources, we have multiple sources of funding that put technology in our school – but without administrative support to make sure the technology is being used, and being used correctly, won't see anything but traditional teaching, which our student data proves does not work!

High-Tech Teachers 1 and 2 emphasized the importance of project-based learning, but indicated that administrators do not support them in those efforts; in fact, they are criticized and discouraged from non-traditional teaching practices, despite the fact that test scores indicate that that they contribute to student learning; in fact, the superintendent told teachers that no more than 20% of students' grades could come from project-based activities. The technology director and all four teachers interviewed stated that currently there is no administrative emphasis placed on technology use or integration or more effective teaching methods, which represents a vast change from the support received by the previous administrators during the technology grant implementation and the State Department of Education 1:1 grant.

The superintendent confirmed the decrease in emphasis on curriculum integration training and support in his interview, stating that since the last initiative (the 1:1 grant implementation):

> There really hasn't been much emphasis. Different levels of adoption is a fact of life; although during the first year we gave release time every Wednesday that

was dedicated to technology integration, but it is no longer exclusively for that purpose.

Ironically, the superintendent followed up his description of the lack of supportive conditions at the school with remarks indicating he understands the importance of leadership in school technology efforts. He described three different kinds of administrators:

> Those who provide no support for technology, those who support technology and model its use, and those who don't know tech but stay out of the way. Well, maybe a fourth type – those who, because they have technology and infrastructure and a lab, they think they have a technology-rich environment – these are the most dangerous.

It is interesting to note that the other five interview participants indicated that they see the current administration to be the one described as "the most dangerous type." Both of the High-Tech teachers responded that the current superintendent does not fully understand what is involved in using technology authentically, does not hold teachers accountable or assist them in using technology, and does not support teachers who use new and innovative teaching practices.

A review of documentation and field notes from the technology grant implementation reveals that the administrators who were at the school during the 2009-2010 school year provided a much greater level of support to the technology integration efforts. Teachers received full-time, on-site technology integration training and support, which was available and required of every teacher, to help them learn how to use the technology authentically within their curriculum. A full time position was created to

provide this curriculum integration support, however the position was eliminated when the financial need to return that individual to the classroom took precedence over the curriculum integration support needs.

A deeper analysis of the data concerning administrator support identifies three sub-themes that are described below. They are shared leadership, teacher accountability, and the use of data to guide instruction. Each of these three sub-themes recurs across the three sets of data used in this study, which indicates that leadership or administrator support is an overarching theme which has effect on and surrounds the other three themes of availability and reliability of technology, curriculum integration training and support, and teacher collaboration.

Subtheme - Shared leadership. Field notes and documentation from the technology grant implementation year show that school leaders were extremely supportive of technology integration efforts, establishing Learning Teams of teachers who worked together to plan technology-rich lessons, hiring a full-time curriculum integration support specialist, and providing release time for teachers to receive regular technology integration training. Additionally, they sent teachers to conferences to learn from other organizations, provided teacher visits to other technology-rich schools, and designating a weekly early-release day during which technology integration was the primary focus. Since that time, most of these structures have been eliminated. Although grant documentation indicates the planned use of teacher feedback via surveys to ensure proper use of technology in classrooms, teacher interviews reveal that those surveys have not continued past the initial grant implementation year, and teacher input to leadership is informal or nonexistent. All interview participants stated that there is little leadership

sharing at Pleasant Valley School today, which represents a radical change from the technology grant implementation year.

Subtheme - Teacher accountability. All four teachers and the technology director have concerns about teacher accountability for the appropriate use of technology within their teaching. The individual who held the position of curriculum integration support specialist in previous years is now a full time teacher, and is one of the teachers interviewed. She indicated that since teachers are not held to a standard for technology use, it was too frustrating for her to act in a support role and provide technology integration training. She stated:

> It takes someone who will stand up to them; to check on them to make sure they are using the technology and using it in the right ways. Otherwise, they revert back to textbooks and worksheets, and the student test scores show it!

According to Low-Tech Teachers 1 and 2, there many of the 1:1 grant laptop computers are never removed from the cabinets. The LoTi program that the school is using involves classroom observations and feedback, but there are teachers who refuse to allow observations in their classrooms, and who are not required to participate. All four teachers and the technology director stated that although teacher evaluations have components that address technology use, administrators do not require any teachers to actually use the technology, nor do they observe and evaluate how the technology is used. According to High-Tech Teacher 2, there is no expectation that teachers will integrate the technology.

> Teaching authentically with technology is a lot of hard work; if they are not required to do it, many of them will not go to the trouble to learn how, and will go back to traditional teaching practices, textbook and worksheet.

The technology director elaborated further on the subject of administrative issues:

> To be painfully honest, I see so many opportunities being missed. I came from the business world where you are evaluated on your performance and your results. That should be true in education as well. There should be formative and summative assessments for every student, every year, so they know what they need to improve on. Students need to know what is expected of them in order to score higher on the tests. Teacher evaluations need to show what teachers need to do to improve. Evaluations are in many cases a joke – you're doing a great job, sign the bottom line!

According to High-Tech Teacher 2, teacher evaluations are done using a Tulsa model, which includes evaluation of the teachers' use of technology, but "everyone gets a pass on" the technology component. She stated that she believes leadership should set a tone and an openness to try new instructional methods. She believes the openness has to come first before accountability; the administrator "must provide a culture and expectation first, then follow up with accountability later on. We need leadership that gets it!"

Although field notes from the school's technology grant implementation year show that the previous superintendent and the principal attended each of the monthly professional development sessions that were provided by the grant, and required every teacher to attend each of the sessions, and to participate as part of a learning team, the

current superintendent stated that the professional development for the 1:1 grant was optional, and there are several teachers who never attended.

Subtheme - Use of data to guide instruction. In past years, particularly during the technology grant implementation year, teachers and administrators regularly met to go over student data, and address issues by working together. Field notes and grant documents show that there were regular meetings of the administrators and teacher leaders to go over student data, and adjust teaching activities based on how students were progressing. The use of data to guide instruction was a requirement of the grant, and an element on which the school was evaluated as highly successful.

According to all four teachers interviewed, there is currently no structure or requirement for the use of student data. The technology director said there are key teachers who stay abreast of student performance data and adjust their teaching as they go, but there is no requirement for teachers to analyze the data, and no structure to facilitate it. High-Tech Teacher 1: "We can show the administration test scores that prove that students engaged in project-based learning are consistently scoring higher than those in traditional (textbook and worksheet) classrooms." When High-Tech Teachers 1 and 2 showed student achievement data to other teachers and the administrator, the data showed that the students who participated in project-based learning activities scored higher on tests, they were told to limit projects in their classrooms. Low-Tech Teacher 1 indicates there is no time or opportunity to look at student data and try to find a way to address issues. "If it was something we set time aside for, and worked together on it, I'm sure it would be useful." Following the overarching theme of administrator support, the

next most frequently occurring theme is the need for curriculum integration training and support, and how the level of this support has changed at the school in recent years.

Theme Two: Curriculum Integration Training and Support

Many researchers have studied how technology should be used in order to have the greatest impact on student learning. Studies find that technology should be fully integrated into the curriculum, in learner-centered activities rather than simply developing technology skills that are used in traditional, teacher-centered practice (Brush & Saye, 2009; Ertmer, 2005; Hew & Brush, 2007; Koehler & Mishra, 2008; Mishra & Koehler, 2006; Polly & Hannafin, 2011). Sandholtz et al. (1997) find that technology is most powerful when students use it as a tool to solve problems, develop concepts, or create products. However, the literature indicates that there is a widespread scarcity of training and support for teachers attempting to adapt their teaching to integrate technology tools that are available to them (Albirini, 2006; Groff & Mouza, 2008; Ozden, 2007; Sicilia, 2005; Toprakei, 2006).

The absence of adequate technology-specific professional development and ongoing support for teachers working to create technology-rich lessons is a significant barrier to technology integration success (Bingimlas, 2009; Hew & Brush, 2007; Hinson, LaPrairie, & Heroman, 2006; Hixon & Buckenmeyer, 2009). Without the needed training and support, many teachers simply do not use the technology, or use it in traditional, teacher-centered ways such as drill and practice (Ertmer & Ottenbreit-Leftwich, 2010; Mishra & Koehler, 2006; Mouza, 2011; U.S. Congress Office of Technology Assessment, 1995; U.S. Department of Education National Education Technology Plan, 2010). Large-scale national surveys of teacher technology use show an

increase in use for non-instructional purposes, but no increase in technology-based learning activities for students (Bakia, et al., 2009).

There is substantial literature that describes structures and policies that contribute to successful teacher technology integration. Several studies support the need for ongoing, high-quality professional development, along with day-to-day support, to enable teachers to make the best use of the technology resources they have available (An & Reigeluth, 2011; Bingimlas, 2009; Dexter, Anderson, & Ronnkvist, 2002; Granger, et al., 2002; Means, 1995). Green (2010) finds that professional development activities that help teachers to seamlessly integrate the technology into their content was far more valuable to respondents than basic "how-to" training, and was perceived as more valuable than the acquisition of the latest technology equipment.

At Pleasant Valley School, the level of curriculum integration support has not had as much emphasis as in the past, when the school was implementing the technology grant and the 1:1 student computer grant. According to grant documentation and reports, grantor organizations provided regular technology-centered professional development, teams of teachers were established to provide ongoing support to their peers, release time was provided every week that was used exclusively for technology integration training and sharing of lessons, and a full-time technology integration support specialist was on staff to work with teachers on creating technology-rich lessons. According to the technology director:

> The current administration does not see the value in that. The individual who held that position is now back in the classroom full time, and she helps others

> when she can, but she is not provided any release time for providing training and support.

The technology director also said she is hopeful about a new hire that will hopefully be supporting teachers with integration, but she is not sure how it will be structured.

The superintendent admitted that technology integration professional development and support has not been supported well this school year. When I asked about the level of technology integration training and support provided by the current technical support staff, he said,

> Well, there are two different kinds of support – those who understand curriculum integration, and the 'wireheads.' Most of the time you can't find both skill sets in the same person, and too many times the 'wirehead' fixes the problem but doesn't show teachers how to integrate or how to fix things themselves.

However, in answering a follow-up question about the qualifications of the technical support staff, he stated that at least one staff member has both skill sets, technology integration as well as technical "wirehead" knowledge. He then stated that the person has no time to spend providing integration training and support, due to the workload involved in "just keeping things going." When asked if there were plans to re-establish the position of curriculum integration support specialist, the superintendent said that there was no funding available at this time, and he didn't believe there would be in the near future. According to Zhao and Bryant (2006), a technology mentor such as a school integration specialist or facilitator who is available to work with teachers in their classrooms, giving one-on-one support, after technology training has ended, helps teachers feel less stress, and progress more rapidly in seamless technology integration.

Field notes from my observations show that on one of the early release days that were originally intended for curriculum integration training, teachers were released to run errands, and in one case, to meet with me for the interview. The technology director and three of the four teachers interviewed specifically addressed the loss of the dedicated full-time curriculum integration support specialist, indicating that current administrators seem not to value that position and its importance to the teachers.

High-Tech Teacher 1 described the technology training that is currently being made available as rare, one-day only, with some occasional follow-up. "It may be adequate for teachers who come naturally to technology, but for others? Probably inadequate. It overwhelms teachers who are new to technology; too many initiatives, and not enough support for each one." According to High-Tech Teacher 2, "Technology is great, but instructional strategies are where the important learning is, and there is no willingness to discuss changing instructional strategies. The big issue we have right now is there's no focus on how technology is used." Low-Tech Teacher 1:

> My biggest challenge right now? Lack of resources that I can incorporate into my curriculum – there's no curriculum integration support specialist any more that I can ask about that. There are lots of good ideas out there, that sound good, but do they work? How do I find resources that are high quality, feasible, effective, and match what I need to teach? There's nobody to ask now.

Low-Tech Teacher 1 described himself as fairly technology literate, and mentioned several technology-based projects his students had worked on when there was a curriculum integration support specialist to help guide him, and especially to help him with assessment of project-based lesson activities. He described his experience with

trying to locate or develop technology-based lessons as being frustrating, because he didn't know where to look for ideas and activities that he could use in his classroom.

Low-Tech Teacher 2 had a very different take on technology integration support – he described himself as self-taught, and asserted that he does not need any technology integration help. "I hold a master's degree in technology integration, so I do not require any of that training. But if other teachers needed it, the superintendent would provide it. He just finds a way to make it happen." A follow-up question confirmed that there are no regularly scheduled training or support sessions for helping teachers learn to use the technology within their curriculum. This teacher stated that his use of technology does not generally involve project-based learning, and further conversation revealed that his students are using technology in more traditional ways. He also described his use of technology as being "over 20 years ago" and indicated that he had not kept up with the most current resources. He cited the lack of student access to technology at home as one of the reasons he does not assign projects, or attempt to work with other teachers on cross-curricular learning experiences. He described most of the teachers at Pleasant Valley as isolated, within their own four walls.

Theme Three: Teacher Collaboration

The effectiveness of peer support and teacher collaboration to achieve technology goals is an important element identified by Ebersole and Vorndam in their 2002 case study of university faculty members and their perceived barriers to successful technology integration. Becker and Riel (2000) cited the effectiveness of peer support and teacher collaboration in achieving technology goals. In a study of K-12 teachers and administrators at 21 grant recipient schools, Williams (2006) found a positive correlation

between teacher collaboration and technology integration in the teaching and learning process. Staples, Pugach and Himes (2005) find that the most successful schools in their study had a formal structure of teacher leaders to assist others in their efforts to make the technology a part of their teaching. Teacher collaboration is seen as an important element in the International Society for Technology in Education (2009) conditions essential to effectively leverage technology for learning. Included are technology-related professional learning plans with dedicated time to practice and collaborate.

During the grant implementation year and the State Department 1:1 grant year, teacher collaboration was a regular part of the professional development, as well as the ongoing work of the teacher teams. Grant documents reveal that a successful professional learning community was in place, and that teams of teachers were regularly preparing and presenting technology-based lesson activities to the rest of the teachers. As recently as the 2010-2011 school year there was an active program of peer classroom observations and collaboration to improve student learning experiences, but with the change in administration, there is now no formal structure or release time for teachers to collaborate. According to the technology director and the teachers, weekly early release time, which was originally implemented to provide time for technology integration training and collaboration, is now used for faculty meetings, dentist appointments, and informal conversations, but not for technology integration.

All four teachers interviewed indicated that there is no teacher collaboration going on now other than the informal conversations that teachers have when discussing a particular lesson or when teachers ask for help from the more technology-proficient teachers. All agreed that the reason there is so little collaboration is that there is no time

allocated for it, no common plan or release time, and no support for it from the administration. Field notes from classroom observations this school year show that teachers were generally isolated in their classrooms, with no evidence of teachers working together other than the two High-Tech teachers who collaborate informally and outside the school day.

Each of the four teachers objected to the use of the early release day for activities that do not support them in their teaching. Low-Tech Teacher 1 emphasized the effects of the loss of the curriculum integration support specialist position; having that person to work with to find lesson resources and to ask questions was very effective. "Without that full time person, our programs have suffered a lot. Use has definitely tapered off due to lack of support. How to use it to teach – that's where we don't have any support now."

When asked if teachers work together for technology integration support, High-Tech Teacher 1 stated that there is no formal structure, the learning teams are long gone, and he rarely is asked a question about how to use the technology. He suspects the reason for that is that very few teachers are actually using the technology. He said his observation was that very few teachers are even using the laptops or tablet computers on a regular basis, and when they are used, they are being used only as textbooks or typewriters, and not in any project-based lessons. He stated "I would work with other teachers and help them if they asked; but they don't ask."

Subtheme - Teacher resistance. Analysis of the data identified teacher resistance as a strong sub-theme of teacher collaboration. Teacher acceptance of technology is a complex issue. Pavlou, Liang, and Xue (2007) identified uncertainty as one of the factors that may prevent teachers from readily accepting the use of new

technologies in their teaching. Given high stakes testing and the demands placed on teachers to produce high test scores, teachers may be unwilling to embrace something that they are unsure will help their students learn. According to Zhao and Cziko (2001), teachers' perceptions of computer technologies for use in the classroom are influenced by three principal beliefs; that technology can more effectively meet learning goals than their current methods, that the use of technology will not disrupt instruction and interfere with goals that the teacher may perceive as more important, and that teachers will receive the training and ongoing support they need to make the technology a useful tool.

One of the most frequently discussed issues in all four teacher interviews and the interview of the technology director is the subject of teacher willingness or resistance to using technology in their teaching, learning new ways to teach, and collaborating with their peers. Each of the four teachers interviewed stated their wish that structured teacher collaboration and teacher teams would be reinstated. They described a widespread unwillingness of teachers to use the technology or to change anything about the way they teach.

The technology director said that many career teachers simply left the school last year, rather than take part in the initiatives that were in place. "Teaching authentically is hard – it's much easier to hand out a worksheet and tell them to open their books to Chapter 5 and fill in the blanks." The technology director provided more evidence of teacher resistance and the non-use of technology or more authentic teaching methods:

> There's this middle school math teacher who wants nothing to do with technology; just wants to use textbooks and worksheets. When we started using the LoTi program, which involves other teachers observing your classroom,

> analyzing your teaching, then collaborating with you to improve yourself, she refused to let anyone come in and observe her class. She's married to the middle school Principal, so when she told him she didn't want to use LoTi, he ended its use and told everyone else they didn't have to work on it.

The technology director and three of the four teachers interviewed also described several recalcitrant teachers who will not observe other classrooms or allow observers in their own rooms. They confirmed that professional development is optional, and there are a number of teachers who do not participate. Teachers who had previously been very involved in supporting other team members with technology learning described the current situation in terms of what they had lost, with the support position, accountability for participating, release time, and an administrator who understands. When I asked the superintendent about how he works with resistant teachers, he cited the high turnover that had occurred at the end of last school year, and said:

> I prefer to deal with the living – work with those who care. We have to make sure the training has a compelling point that makes them want to learn about it. A few years ago the technology professional development was highly effective, but there's an ebb and flow in school systems. If you keep pushing constantly, it causes resistance; teachers get worn out. It doesn't bother me to back off for a while, allow teachers to breathe and not be on a big push constantly.

On the topic of teacher resistance, Low-Tech Teacher 2 said:

> There has to be teacher interest in using technology. Things I'm not interested in, I won't be motivated to do. Teachers can't be forced to use the technology – they

have to be interested in using it. Motivation is the issue here. It's lots of extra work usually.

Documents from the technology grant show that in the 2009-2010 school year, all teachers were required to attend every professional development session, and the superintendent and principal not only attended, but also were active participants. Every teacher was a member of a learning team, received the support of their team members as they worked on learning the new technologies, and was responsible for preparing and presenting technology-rich lessons to their team members.

The data suggests that current conditions and structures at the school work more to inhibit or prevent technology use, and there is little motivation or encouragement for teachers who may be reluctant to learn to use the technology in authentic ways. The final theme presented by the data emphasizes the importance of readily available and consistently reliable technology.

Theme Four: Availability and Reliability of Technology

The amount and variety of technologies available in schools has increased dramatically, with education spending on information technology in the United States topping $50 billion in 2011, projected to rise to over $59 billion in 2016 (Compass Intelligence, 2012). Many studies reinforce the value of using instructional technologies in student-centered, technology-rich learning activities, providing challenging content that is aligned to standards, in an environment where technology is reliable and teachers receive ongoing training and support in technology use and curriculum integration (National Educational Technology Plan, 2010; O'Hair & Reitzug, 2006). Researchers find that teachers will not use technology if it does not work consistently, quickly, and

with little overhead in terms of teacher time spent in preparation and troubleshooting (Hew & Brush, 2007; McNierney, 2004; Ringstaff & Kelley, 2002; Staples et al., 2005). Unless technology is easily accessible, reliable, and consistent in performance, teachers are likely to be discouraged from making it a part of their practice (Peck et al., 2011).

At Pleasant Valley School, availability of technology is definitely not an issue. According to the technology director, the school has moved from one or two computers in a few classrooms to district-wide wireless network access, every sixth, seventh, and eighth-grade student issued either a laptop or tablet computer, at least six computers in every pre-K to third grade classroom, student response systems, interactive whiteboards, and class sets of smartphones for student use for internet research. Site visit field notes show that almost every classroom has been equipped with some type of instructional technology tools, and a review of the school's grant application, as well as the State Department of Education 1:1 grant documentation, indicate a very high level of technology availability. The school's technology infrastructure was upgraded this year at a cost of $360,000. "We have the funding, through grants or other resources, to provide almost any kind of technology available, a grant writer who is passionate about technology…putting technology in the students' and teachers' hands is not the problem." The superintendent confirmed that availability of technology is not limited in any way at Pleasant Valley School:

> We have over 84% students on the free & reduced lunch program, so we receive a substantial amount of eRate funding. We have a high percentage of Native American students, so we apply for all those grants as well. If a teacher decides

he or she needs technology equipment, if they make a good case for it, they will generally receive it. We find a way.

High-Tech Teacher 2 agreed, commenting, "Availability is not the problem, access is not the problem – our bandwidth is excellent. There is technology available here that some teachers don't even know we have." It is evident from conversations with the superintendent that he believes Pleasant Valley School to be technology rich. While access to technology at the school is almost unlimited, the effectiveness of its use in the classroom can be affected by several factors, including the need for increased availability of highly qualified, on-site technical support personnel.

There are indications that the school may suffer from what Fullan (2008) calls "initiativitis" (p. 1): the implementation of many change efforts without attention to how the programs relate to each other, existing programs, or the participants within the school. The technology director cited the large number of programs being implemented at Pleasant Valley, with grant after grant being sought and received, as possibly having affected the high teacher turnover they experienced in the past two years.

Subtheme - Technical support. The increase in technology availability carries with it the need for more effective technology support, and places additional demands on administrators, teachers, and technology support personnel. Studies find that technology support may be as important to educational technology use as is the availability of hardware, software, and network connectivity (Kramer, Walker, & Brill, 2007). Without timely, high-quality technology support, teachers and students experience frustration and dissatisfaction, it is unlikely that technology will be used (Ebersole & Vorndam, 2002; Koul, et al., 2011; McNierney, 2004).

At Pleasant Valley School, there are currently two full-time technology support positions and one part-time support position, and they are responsible for both hardware and software support. Observation field notes confirm that the technology director and two additional staff members are available to provide timely technical support on most occasions. The individuals currently holding the technical support positions are self-trained, although one new employee has a degree in computer science, and according to the superintendent is given the opportunity to attend any additional training needed. When I asked about the percentage of the school's technology budget that is allocated to support, the superintendent was unable to provide exact information, but he indicated it is a very small percentage of the overall technology budget.

Both the technology director and the superintendent indicated that technical support response times are good, and described the quality of technical support as excellent. High-Tech Teacher 1 agreed that technical support is prompt, with most problems resolved within a day or two, although the full-time person had only been there for two months, so he did not yet have much information as to the competence or knowledge level of that individual. Although most issues are corrected quickly, he remembered a network access issue that required more than a week for resolution. High-Tech Teacher 2 agreed that in general, technical support response times are adequate and described an e-mail problem-reporting system that is in place to make sure issues are documented. When asked about technology support availability and quality, Low-Tech Teacher 1 responded somewhat less favorably:

> Some help desk support is available, and they are fairly tech-savvy, but unfortunately due to workload, priorities, whatever unknown reasons, I have

three issues that I reported at the beginning of the school year, and they still have not been fixed, three months later.

Although he used the e-mail reporting system to report a new problem recently, he had not received a response after several days had passed. "When I contact administration, I can usually get some help." Low-Tech Teacher 2 reported similar experiences, with extended wait times on repair of student laptops. Although he described the technical support personnel as willing and trying to be helpful, he still has to wait a week or more to have a laptop repaired and returned to his classroom.

Both of the Low-Tech teachers indicated they have experienced technology problems that required that they return to traditional methods, using textbooks and worksheets, or written hand-written homework assignments. High-Tech Teachers 1 and 2 described their responses to technology problems as being decidedly different – they usually take care of problems themselves, or find another way to accomplish the purpose. For example, when a laptop was broken in High-Tech Teacher 2's classroom, the student used the teacher's smartphone to do research on the web.

Although responses concerning technical support were mixed, all four teachers and the technology director expressed great concern over the lack of training and support available in the area of curriculum integration, and best practices for using the technology to provide the best learning experiences for their students. Of those interviewed, only the superintendent believed that current technical support personnel have curriculum integration knowledge and skills. The following summary of findings reviews the themes and identifies three specific areas that teachers and the technology director perceive as crucial to sustain the success of technology integrations in the school.

Findings

As shown in the model on page 70 and detailed in the discussion above, the four themes that emerged across the three data sets work together to answer the research question by highlighting structures, conditions, and supports that are needed for schools to successfully use instructional technologies to the greatest benefit of their students. While answering the question raises a number of issues, three of the most significant in the responses from teachers and the technology director are (a) the need for administrators who are fully aware of and committed to the authentic use of technology in the classroom, and dedicated to supporting the changes in teaching strategies as well as leadership methods that are required for successful technology integration; (b) extensive and ongoing curriculum integration and support, and (c) teacher collaboration and peer support.

The active engagement of school administrators, supported by full understanding of the nature and importance of authentic use of technology, is the most often cited issue at Pleasant Valley School. This theme encompasses all other themes, and appears to be a key element in providing the support for curriculum integration support and structures and accountability for teacher collaboration.

It is clear from the data that without effective, ongoing curriculum integration training, along with readily accessible, day-to-day support, technology is being used merely to automate traditional teaching practices. In the absence of structures that motivate, enable (and require) teachers to work together and support each other's practice, only those teachers who are technologically advanced will succeed. Given the pressures of high-stakes testing, teachers less comfortable with technology revert to

traditional teaching methods, technology is unused, and student achievement suffers. Chapter Five provides analysis and discussion of these findings, along with applications for practice and suggestions for further study.

CHAPTER FIVE

Conclusions and Recommendations

This chapter briefly restates the problem, purpose and significance, and design of the study. The focus of the chapter is to discuss and draw conclusions about the results, to connect the results to the existing literature or theoretical framework, and to interpret the data and how the sources of data work together to answer the research question. Implications for practice and suggestions for further study are also included.

Problem

Despite the increase in technology available to classrooms, the research on the impact of technology on student achievement has been mixed at best. Studies consistently show that if technology is effectively integrated it is much more likely to affect student learning, however, researchers have identified numerous barriers to the successful integration of technology into curriculum. Two of the most often-cited barriers are the lack of adequate technology professional development and inadequate hardware/software support (Bingimlas, K., 2009; Hew & Brush, 2007; Hinson, LaPrairie, & Heroman, 2006; Hixon & Buckenmeyer, 2009).

Purpose and Significance

This study examines the experiences of teachers, administrators, and technology directors engaged in technology implementation programs in a technology-rich school, in an effort to identify characteristics, structures, conditions, and practices that contribute to or interfere with successful integration of technology into curriculum. The study addresses a gap in existing literature concerning the importance of the role of support,

both technical support and curriculum integration training and support, in the success of school technology programs.

Although there is considerable evidence that the use of technology as a tool in authentic, student-centered learning activities can positively influence student learning, much of classroom technology is unused, or used only to support traditional teaching practices. The lack of qualified, timely technology training and support is cited as a barrier to success by many researchers, yet few studies are focused on the support issue and its effect on creating technology-rich learning environments. This study narrows the focus to the structures, factors, and practices that teachers, school leaders, and technology directors identify as having impact on their success.

Research Question

To build on existing literature and further examine the issue of instructional technology training and support and its implications, this case study examines a technology-rich school in an effort to answer this research question:

> What structures and conditions for instructional technology training and support do teachers, school leaders, and technology directors identify as critical to the success of their classroom technology integration efforts?

Design of the Study

This study answers the research question using a qualitative case study, "an in-depth description and analysis of a bounded system" (Merriam, 2009, p. 40). A qualitative case study involves the search for meaning where the researcher is primarily responsible for collecting and analyzing data. An in-depth study of the selected case, anchored in real-life situations, can result in rich understanding of the phenomenon, and

have impact on and even improve practice (Merriam, 2009). The bounded system selected for this study is a technology-rich K-8 school in rural Oklahoma. This case study is descriptive, observational, and heuristic, and includes gathering and analysis of three separate sets of data, and provides insights into relationships and variables, and greater understanding of experiences (Stake, 2007). Data includes interviews, observations and field notes, and documentation from the school's technology grant implementation year.

The school was purposefully selected, "based on the assumption that the investigator wants to discover, understand, and gain insight and therefore must select a sample from which the most can be learned" (Merriam, 2009, p. 77). The case school was evaluated as achieving significant progress in meeting the goals of their technology grant, based on performance measures of the grantor organization. Within the purposeful selection of the school, individuals to be interviewed were selected based on either the function they fulfill at the school, or in the case of the teachers interviewed, their level of technology integration in their classrooms.

Conclusions

The data collected and analyzed in this study answer the research question: What structures and conditions for instructional technology support do teachers, school leaders, and technology directors identify as critical to the success of classroom technology integration efforts? As presented in Chapter Four and illustrated in the model on page 70, four themes emerge from the three sets of data to answer this question. These themes highlight the structures and conditions that the participants in this study deem critical to their success in teaching with technology. They include administrator support,

curriculum integration training and support, teacher collaboration, and availability and reliability of technology. Since the availability of technology is of little concern at Pleasant Valley School, where multiple technology grants and many sources of technology funding are available, and the responses concerning reliability of the technology were mixed, the three primary themes that are described as most critical to the participants are administrator support, curriculum integration support, and teacher collaboration.

Administrator support. The support of administrators is an overarching theme that encompasses the other two primary themes that emerged. The importance of administrator support is reflected in existing literature. Byrom and Bingham (2001) find leadership to be the single most important factor affecting the successful integration of technology in schools. Studies show leadership and administrators' ability to lead is significant in determining the success of implementing new technology (Anderson & Dexter, 2005; Hayes, 2007). Teacher and technology director interview transcripts in this study show that administrator support is by far the most discussed issue at Pleasant Valley School, and the remaining themes of curriculum integration training and support, and teacher collaboration, are influenced by and point back to leadership practices and attitudes. It is clear from the data that teachers view the support of their superintendent is the highest priority need for their success in technology integration. The importance of administrator support can be more clearly explained by breaking it into the subthemes found in the data. The first subtheme is the concept of leadership sharing, and teacher input into school decisions.

Shared leadership. Within the broader theme of administrator support, interviews and observations during this study show that teachers are not included in decision-making at Pleasant Valley. Although this school exhibited excellent growth in the area of shared leadership during their grant implementation year, it is clear from the data in this study that the change in leadership has reversed that growth. Interviews indicate that there is no opportunity for teachers who have achieved success in technology use to work with their peers who have been less successful, unlike in previous years where teams of teachers worked together. Teachers and the technology director state that the Learning Teams of teachers that were created in 2009-2010 have disappeared, and that the leadership has reverted to traditional, top-down management by the superintendent. There is no structure in place to allow teachers to share in the decision-making at the school, curriculum-related or otherwise, and suggestions for change have not been well received.

The literature supports the positive effect that shared leadership and horizontal communication can have on school reform efforts. Studies show that administrators alone cannot provide sufficient leadership to systematically improve the quality of instruction or the level of student learning. Schools show the best results when administrators are strong leaders who also welcome and cultivate leadership by teachers (Marks & Printy, 2003). Lindahl (2008) describes the roles teachers can take in participating in the leadership of the school, including school planning – not just operational planning or administrative functions, but planning how the school's vision should be carried out in the classroom, in curricular practice and in school culture.

Teacher accountability. All interview participants, including the superintendent, confirm that there is little accountability for teacher use of technology, let alone accountability for authentic, student-centered technology integration. Interviews and observations confirm that there are teachers who never take the student laptops out of the cabinet, some teachers refuse to allow observations in their classrooms, and teacher evaluations, although containing a component for technology use, are marked as satisfactory even though no technology use is taking place. Without setting a tone of high expectations, along with ongoing support and accountability, many teachers are taking the path of least resistance, and returning to traditional teaching.

Use of data to guide instruction. Another aspect of the administrator support theme is expressed by all of the teachers interviewed, as well as the technology director. They indicate that the structure for teacher groups to work together to analyze student data that was implemented during the technology grant implementation year is no longer in place, and that most teachers do not track student data to guide their teaching. Only a few key teachers stay abreast of their students' progress and modify instruction based on that data. Interviews show that since there is no time designated for data analysis, it is not done.

The administrator in this study, although he described himself as technology-proficient and clearly possessed considerable background and knowledge about technology integration, has not supported the structures and conditions that the teachers and the technology director agreed are so critical. His interview responses and anecdotes concerning technology integration in his earlier career, as well as the current conditions at the school, indicate that his knowledge of the authentic use of technology in student-

centered learning experiences, may not be current, and his role in and effect on the other two primary themes of curriculum integration training and support and teacher collaboration should not be minimized.

Curriculum integration training and support. Following administrator support, the absence of curriculum integration training and support is the next most prevalent theme in the data. The loss of on-site, full time curriculum integration support is mentioned by all interview participants, and is given considerable weight in the discussion of the level of technology integration taking place at the Pleasant Valley School. The literature supports the need for ongoing training and support in how to use technology to enhance student learning. Many studies indicate that technology should be fully integrated into the curriculum and used in the context of learner-centered activities rather than simply developing technology skills in traditional, teacher-centered practice (Brush & Saye, 2009; Ertmer, 2005; Hew & Brush, 2007; Koehler & Mishra, 2008; Mouza, 2011; Polly & Hannafin, 2011). Kleiman (2009) states that the key to successful technology integration is in how we define educational goals and visions, prepare and support teachers, and design technology-rich curricula.

Based on interview responses, all of the teachers, both high technology users and minimal technology users, consider the need for re-establishing the full time curriculum integration support specialist position as critical to the success of many teachers. In addition to the need for the on-site support position, the data points to the need for the school to renew the use of early release time during the school day, to be dedicated to curriculum-integration training, practice, and sharing best practices. Beyond the need for

curriculum integration training and support, the ability and willingness of teachers to collaborate and support each other is important in the data gathered in this study.

Teacher collaboration. The ability of teachers to work together in meeting the challenges of technology integration is the final major theme emerging from the teacher interviews, field notes, and grant documents. Although the structure for teacher collaboration was strong during the technology grant implementation year, learning teams were discontinued the next school year, and release time is no longer provided for teachers to work together. With the loss of the full time curriculum integration support specialist, little remained in the way of opportunities for teachers to support each other in their technology integration efforts. Teachers described the problem with trying to collaborate without the benefit of release time or common planning periods for groups of teachers who need to collaborate as being the main reason that little collaboration takes place at Pleasant Valley School anymore.

The literature supports the need for teacher collaboration, with studies finding that the most successful schools had a formal structure in place for teacher leaders to assist and guide others (Staples, Pugach & Himes, 2005). Ebersole and Vorndam (2002) cite the effectiveness of peer support and teacher collaboration to achieve technology goals. Studies find that teachers cite learning from collaboration with peers, on-the-job discussions, and conversations with other teachers as being more useful than structured workshops (Granger, 2002). In a study of the development of professional learning communities, Williams (2006) finds that principals and teachers stressed the importance of having time to meet, collaborate, discuss and learn together. According to Schlager

and Fusco (2003), administrators must create and maintain an atmosphere conducive to open and honest communication among teachers.

The themes of curriculum integration training and support and teacher collaboration connect to the overarching theme of administrator support, and the role administrators play in providing the resources and conditions that are necessary for schools to achieve the goal of technology-rich, collaborative teaching. The issues that appear repeatedly in the data that prevent the school from achieving that goal include the absence of on-site, full-time curriculum integration training and support, lack of release time that is dedicated to technology teaching strategies and collaboration, administrator attitudes toward and lack of support and for, and even discouragement of, project-based learning and cross-curricular lesson activities, and the lack of teacher accountability and motivation for attending professional development or using technology in their teaching. All of these issues are directly relatable to the attitudes and practices of administrators.

Pleasant Valley School, Then and Now

From the data collected in this study and my own experiences working within the school, it is clear that Pleasant Valley School was a success story in its technology grant implementation year. The school continues to be technology rich, strictly in terms of the number of technology tools that are available to teachers and students. Interview responses confirm that additional technology is being acquired regularly. At first glance it appears that Pleasant Valley is still a place where authentic, technology-rich learning opportunities are available to all its students. What I learned in this study paints a decidedly different picture, and indicates that much has changed since the school's grant performance evaluation. Much of the technology is unused, and many teachers have

reverted back to traditional teaching practices using textbooks and worksheets. In only a few classrooms, teachers continue to offer technology-rich, project-based learning opportunities for their students. Weekly early release days that were originally intended to provide curriculum integration lesson sharing and professional development are being used for administrative tasks or teacher errands. Teachers who worked together to develop teaching strategies and cross-curricular lessons, observed their colleagues' classrooms, and provided feedback and learned from each other are now isolated within the four walls of their classrooms, their students using worksheets and textbooks while laptops and tablet computers gather dust in the closets.

Contrast the current environment at Pleasant Valley School with the experiences of schools detailed in a multiple case study wherein the administrators functioned as instructional leaders. Thomas (2010) describes the principals in the case study schools as playing a crucial role in the technology integration process; strong instructional leaders with high expectations and equally high levels of support for teachers engaged in learning how to make technology a part of their practice. Principals in the case study schools readily shared leadership with all stakeholders, understood pedagogical implementations of technology, and created a supportive environment by observing classrooms, facilitating training opportunities, and meeting frequently with teachers to discuss technology integration and share instructional strategies.

More poignant is the comparison of Pleasant Valley School now, as evidenced by the findings in this study, with Pleasant Valley in 2009-2010, when authentic technology integration, shared leadership, and teacher collaboration was the norm. In the 2009-2010 school year, Pleasant Valley School experienced a transformation from a highly

traditional school with very little technology in classrooms, and very little authentic, student-centered instruction, to become the same kind of progressive, technology-rich learning environment as described in the Clark's (2010) case study. Examination of grant performance evaluation documents show a school that experienced significant growth in authentic technology integration in teaching, professional learning and sharing for technology integration, development of a shared purpose for technology, and development of shared and supportive leadership. A story told by the technology director provides an excellent example of the kind of teaching and learning that was present in the school prior to the current school year. She describes a project implemented by a cross-curricular group of teachers the previous summer.

> Teachers put together a project that included all the elements of authentic teaching, where students used computer research to tour several countries, created maps, studied the foods, music, dances, and religions – everything they could learn about the people they were 'visiting. They wrote journals about their travels, included geocaching to find objects, and made presentations to their classmates. The technology director said that when the teachers who created the project began the current school year, all the emphasis was on testing, 'so they threw it all out the window and went back to teaching the old way (where students learn nothing!)'

From the findings of this study it appears that today's Pleasant Valley School has returned to top-down leadership, traditional teaching practices in all but a few classrooms, little or no emphasis on or accountability or support for teachers to use technology in authentic, student-centered learning activities, and little evidence of teacher

collaboration or shared leadership. The answers to the research question reveal specific conditions, structures, and practices that teachers and the technology director believe to be critical to successful technology integration.

Implications for Practice

Administrator support. Administrator roles are critical in creating the supportive and collaborative environment described above. In the case of Pleasant Valley School, it is the superintendent who makes most if not all school decisions, and he is the individual who has the means and opportunity to develop the kind of collaborative learning community that existed at the time of the technology grant. Principals, or in this case the superintendent, "creates conditions for teacher interaction, including structures and policies that formalize ways in which teachers are expected to work together and processes for doing so" (Printy, 2002; Printy & Marks, 2004, p. 128). Teachers and the technology director stressed the need for the administrator to fully understand and support authentic use of technology within the curriculum, and to provide motivation as well as accountability for teachers who are reluctant or unsure about technology use.

The structures and conditions for providing ongoing curriculum integration training and support, as well as for teacher collaboration, point to the third, overarching theme of administrator support, since the authority to make changes in those conditions appears to lie solely with the superintendent at this school. The return of Pleasant Valley to strictly top-down administration, traditional teaching practices, and teacher isolation, especially given the level of success they achieved in 2009-2010, raises some interesting and unexpected questions about how programs that bring about school change may be made more systemic, to allow them to survive changes in administration, teachers, and

technology support personnel. Evans, Thornton, and Usinger (2012) propose that a full understanding of change theory can help school leaders lead meaningful change efforts, and suggest that school leaders may benefit from examining four major theories of organizational change: continuous improvement model by W. Edwards Deming, organizational learning by Chris Argyris and David Schon, learning organizations by Peter Senge, and appreciative inquiry by David Cooperrider. Evans, et al. (2012) selected these four theories of change "because of their emergence in the field of education, possible adaptability to school systems, and potential to support organizational change" (p. 156). These theories provide clear guidelines for successful organizational change and change management, and may assist school leaders in their efforts to implement school changes. Elmore (2004) describes a positive implication of learning in context:

The development of systematic knowledge about, and related to, large-scale instructional improvement requires a change in the prevailing culture of administration and teaching in schools. Cultures do not change by mandate; they change by the specific displacement of existing norms, structures, and processes by others; the process of cultural change depends fundamentally on modeling the new values and behavior that you expect to displace the existing ones (p. 11).

Curriculum integration training and support. It is clear from the data collected in this study that teachers in particular value the availability of curriculum integration training and support. Given the experiences of Pleasant Valley School, it is apparent that this support should be ongoing, with structures in place that provide teachers with opportunities to observe technology-based lesson activities in other classrooms, and research and develop their own curriculum-based technology lesson

activities. There is also considerable evidence that teachers need time to practice the use of technology, and to have resources available to help them if problems occur. The data show that teachers believe regular, qualified curriculum integration instruction and coaching to be critical to their success. Although the training and support requirements mentioned by teachers and the technology director are considerable, the data also show a need for the development of a collaborative community of teachers, administrators, and technology support personnel who have opportunities to work together to improve the level of technology-based teaching and learning in the school.

Teacher collaboration. As the teachers and the technology director indicated in interviews, a great deal of collaboration was possible in previous years. The existence of learning teams, whether grade-level or content-area based, can provide substantial support for teachers who may be new to the concept of using technology in authentic, student-centered ways. Experiences of teachers in this study confirm the need for opportunities for classroom observation and feedback, as well as time for teachers to work together to evaluate, adjust, and improve their practice in the use of technology-rich lesson activities. The use of release time or creation of common planning times for teacher teams may provide substantial benefit, and enable the more technology-proficient teachers to share their strategies, assist others with issues they encounter in their own teaching, and brainstorm or research new applications or cross-curricular lesson ideas. The ability of schools to achieve the objectives of curriculum integration training and support and teacher collaborative opportunities requires the full support of administrators.

Suggestions for Future Study

Beyond the answers to the research question found in this study, the data raises the question of sustainability of initiatives and programs designed to bring out school change, and suggests the need for future study. The experiences at Pleasant Valley School indicate there is a need to create a more systemic school change that will endure beyond changes in leadership. There is considerable research that describes elements of professional learning communities that contribute to sustainability of programs, and several studies find the process of collaboration, one of the themes emerging from this study, to be critical to the development and sustainability of school change (Atkinson, 2005; Burns, 2002; Riel & Fulton, 2001; Williams, 2006). According to Fullan (2003), sustainability in organizations develops through fostering leadership and commitment in its members, echoing the shared leadership theme found in the data in this study.

The study and use of change knowledge in school organizations may prove valuable in bringing about more systemic changes in schools' efforts to improve student learning. Fullan (2006) suggests that we as educators look past the development of individual leaders, toward the simultaneous changing of individuals and the culture within which they work. He points to capacity building as critical to any type of reform, and defines it as developing "individual and collective knowledge and competencies, resources, and motivation" (p. 9). Future study is needed in the area of developing school cultures that can survive changes in administration.

Summary

There is considerable evidence that the use of technology as a tool in authentic, student-centered learning activities can positively influence student learning. One of the

most often cited barriers to the successful use of technology in the classroom is the absence of qualified, ongoing technology training and support. The themes that emerge from the data in this study provide answers to the research question and add to the existing data by describing the structures, conditions, and supports that the participants find critical to success in implementing technology. I am hopeful that the findings of this study, along with the implications for practice and suggestions for future study, may offer insight and contribute to school technology integration efforts.

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