Digital Stories for Professional Learning: Reflection and Technology Integration in the Classroom

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Dedication

This dissertation is dedicated to my family. No accomplishment of worth is ever completed in isolation, regardless of the number of hours spent alone at "the Ph.D. desk" researching, reading, learning, and writing. Thanks for leaving me alone and interrupting, and having the wisdom to know when it was time for each. I could not have finished this work without you.

First and most importantly, to my wife Diane whose encouragement, support, and unfailing belief in my ability to complete this work lit the way forward when the path began to grow dim. Also to my children Matthew, Laura, and Emily, I hope that long after this work has faded from the field you will remember the example of perseverance it represents. Learn something everyday.

This dissertation is also dedicated to Mom and Dad for your example, and belief in my ability. You've always supported my dreams and modeled lifelong learning for me. To my parents and in-laws (a.k.a. grandparents) your contribution is substantial. The weekend trips to your house, or the beach during writing bursts allowed me to rest assured that my family was in great hands. Thanks for the desk, now I can see the wood again.

I am indebted to mentors who have shown me what scholarly, reflective practice looks like. It is rare to find such individuals in a lifetime, and I have worked with three. Dr. Mark Garis never did join my committee but he showed me what it means to lead a system. Dr. Marion Dugan poured her energy and work into making sure people like me had as much success as possible. Your legacy lives on through the leaders you've touched.

Dr. Liz Haslam, my chair and friend. You have set the bar higher than was ever anticipated and extended more grace than was ever required. Like Marion you have invested in my life and I appreciate it deeply. You showed me what it means to be a scholar and then helped me become one too. Your passion for technology and learning is something that drew us together from our first meeting – driving Volkswagens only helped cement the bond.

Dissertation complete the journey is only beginning. To use the knowledge for service to our children is the wisdom gained from "the other side". My mission continues to be doing justice, loving kindness, and walking humbly with my God. The dissertation will allow me to take the mission to a broader sphere of influence. As a leader I look forward to extending the good work of those who have come before me and contributing to the changes that will make a lasting difference.

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Again I want to acknowledge Dr. Elizabeth Haslam who led, challenged, questioned, provoked, inspired, counseled, and waited patiently until the goal was attained. She continues to inspire me to never stop learning.

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Abstract

Digital Stories for Professional Learning: Reflection and Technology Integration in the Classroom

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Dr. Elizabeth Haslam

A case study design was used to gain understanding of the interactions, practices, and contexts that are hindering or fostering the integration of technology. Qualitative methodology was used to gather detailed data of teachers' beliefs, experiences, reflections, goals, and interactions while they created learning environments that integrated technology resources with their existing curriculum. Data collection included field observations, formal and informal interviews, videotaping, artifacts, student work, and an online questionnaire. Documents and instructional practices were assessed using the Levels of Technology Integration (LoTi) framework and National Educational Technology Standards for Students (NETSS) criteria. Results indicate, culture and context; coaching; evaluation of current integration practice; goal setting for lesson/unit planning; and examining current practice through reflection positively influenced the process of creating high-quality integration.

Chapter One: Introduction

The Research Problem

All types of organizations struggle to share knowledge, solve problems, and remain vibrant while accomplishing their mission and purpose. Educational systems have wrestled with these same struggles. It's not surprising that K-12 institutions have valued additional learning as a primary strategy to address the problems they've encountered. For decades school systems have turned to professional development as a way to carry out new initiatives, manage change, and respond to the complexities involved with students, staff members and ongoing learning.

There is a need to redefine the way staff development happens. Traditional practices are not meeting the need for teacher learning, yet these traditional practices continue to be the prevalent strategies for professional development (Lambert, 2003). An initial step in changing an ineffective model is to delineate components of that weak model – identify what is not working. Robb (2000) identifies four components of the traditional staff development model that inhibit professional growth. One-day teacher training sessions overload teachers with information and fail to address the varying levels of expertise and knowledge among staff members. One-size-fits-all presentations often involves an outside expert who ignores a school's students, teachers, and culture while delivering the same prepackaged program that was already

delivered at other schools. Minimal administrator participation by principals who pop into sessions, or don't attend at all, because of pressing meetings or paperwork sends a powerful message that lifelong learning does not really matter. The administrators and teachers miss valuable opportunities to study, think, discuss, reflect, and continually revise and improve their theories of learning. Lack of follow-up support is often connected to limited funding for staff development. This follow-up is vital for the teachers who take the risk to try new ideas. Lack of follow-up demonstrates that the traditional inservice model has not fully confronted the issue of how and why people learn.

Traditional models of staff development have failed to produce satisfactory results in the integration of technology with student learning. New learning is being delivered in the same ineffective ways that failed to produce transformational change. Although access to educational technology is often plentiful and models of effective technology integration provide a rationale for its practice, technology integration has failed to become a common classroom practice for a majority of teachers (Casey & Rakes, 2002; Moersch, 2002). These findings suggest that efforts to train and motivate teachers to integrate technology have been largely unsuccessful. Teacher learning is stuck in this ineffective model while the pace of ongoing learning continues to accelerate (Becker, 2000; Casey & Rakes, 2002; Harper, Squires, & McDougall, 2000; Lewis, 2002; McKenzie, 1999; Robb, 2000; Sparks & Hirsh 1997c).

Inservice initiatives addressing the role of technology in curriculum have been delivered in the same traditional staff development model just described. The unspoken assumption is that this traditional model can work for technology integration if we merely supply adequate access to computers, software, and network services. But an abundance of technology and connectivity cannot be substituted for a change from the traditional staff development model. Even generous amounts of hardware, software, and connectivity will not automatically result in meaningful integration.

Ongoing professional learning must respond to foster the changes in the learning environment required for effective technology use. Instruction must move from teacher-centered to learner-centered, from isolated work to collaborative work, from focus on facts and content to focus on synthesis, problem solving, and meaning. (CEO Forum, 2000; Forcier, 1999; McKenzie, 1999; Valenti, 2000; Wiske, 2000). This alignment between ongoing technology learning and continued learning about best practices in education reinforces technology integration as a catalyst for change. (Holland, 2001). Ongoing, collaborative learning is a necessary component during successful implementation of change (Brown, 2000; Fullan, 1996; McKenzie, 1999; Nisan-Nelson, 2001). Rapid change is certainly the backdrop of our current efforts in technology integration and school reform.

Wallace's study (2004) suggests that knowing the range of potential uses for a given technology might be a key component of good teaching. This

implies that rapid change cannot become an excuse to forgo "keeping up with the technology." Indeed the opposite might be true, that is teachers need to continually become aware of the tools and consider their implications for the learning environments they manage and design. The use of story and narrative may provide a suitable framework for both students and teachers to develop ongoing understanding and meaning from inside this rapid pace. Ferdig (2004) suggests that we need to more about what it means to teach with and through narratives. Additional studies have pointed to key research needs related to the successful integration of technology. Chief among these areas is the connection to student achievement. Cited components for research include findings to: examine the relationship of technology and how people learn including learning process, engagement and contextual learning; develop models for inservice and preservice teachers to be more effective users of technology; and develop technology-rich instructional models to support student learning (Pollard & Pollard, 2004; U.S. Department of Education, 2000).

This study addresses the gap in previous studies that made little distinction between the frequency of computer use and rich integration connected to student thinking and achievement (Azzara, 2000; Owens, Eaton & Magoun, 1999). It addresses the need to move teachers' technology training beyond the focus of acquiring technology skills to creating rich learning environments with technology resources. This study responds to the School Technology and Readiness (StaR) report findings for new learning

environments in professional development by implementing a learner centered design that promotes improved student learning and cultural change (CEO Forum on Education and Technology, 2000).

Ever since the miniaturization of components made personal computers a reality, K-12 schools, colleges, and universities have been struggling to use technology tools effectively and meaningfully. Connecting core curriculum, student learning and technology has been a struggle. Technology Counts 2001 found that access to computers at home and at school was fairly even, but use at school is not. Their findings indicate, "A full 50 percent of students said they use computers at school zero to one hour a week, while 57 percent said they use computers at home at least five hours a week." (p.48). Sadly, 43 percent of students in schools defined as high-tech in the survey used computers an hour or less each week in school.

The CEO Forum's year three report on School Technology and Readiness (STaR) in June 2000 found a 150 percent increase in the number of multimedia computers from 1996 to 1999. (p. 24). By 1999 a full 95 percent of public schools were connected to the Internet. (p. 29). Yet after this period of hardware and connectivity growth only 33 percent of teachers felt "well prepared" or "very well prepared" to integrate digital content and tools into the curriculum and instruction. (Pp. 24-27). One STaR recommendation is that professional development should focus on moving from traditional to new learning environments.

Current practices in staff development for technology integration often focus on the skills of computer use instead of the process of enhancing and expanding the curriculum through the creation of rich learning environments. Limited exposure to any type of technology training complicates the problem even further. A U.S. Department of Education (2000) study found that over a three year period 77 percent of teachers surveyed participated in professional development activities in the use of computers or the Internet that lasted for 32 hours or less. These teachers were less likely to indicate they felt well prepared or very well prepared to use computers or the Internet for instruction.

Studies That Have Addressed The Problem

In the past our education system was aligned with the development of skills required in an industrial society. Education must now focus on skills relevant to an information economy. By perpetuating the old model of staff development we are severely limiting opportunities for our students to learn the 21st century skills needed for the modern world. Whetzel's (1992) report on Achieving Necessary Skills (SCANS) and the Partnership for 21st Century Skills (2003) report on Learning for the 21st Century found a similar disconnect between a student's K-12 experience and the skills needed to thrive in our current world. Both reports warn that the K-12 learning experience must change to become relevant for students.

The Partnership for 21st Century Skills (2003) reports learning skills necessary for coping in the 21st century extend beyond core subjects. The report notes that we must go beyond content to use knowledge and skills in new situations to think critically, analyze, comprehend, communicate, collaborate, solve problems, and make decisions. Our methods of staff development must change for teachers to engage in the kinds of learning needed to develop skills for analyzing, accessing, managing, integrating, evaluating, and creating information in a variety of forms and media. Communication skills for effective oral, written, and multimedia communication in a variety of forms and contexts is an emphasis recommended by the partnership (Partnership for 21st Century Skills, 2003).

In stark contrast to the relevant skills noted in the SCANS and Partnership reports researchers have identified prevalent conditions that exist today in American education in the following common scenarios (Kurubacak, 1998; Land & Coe, 1998; McKenzie, 1999; Moersch, 2002):

a. teachers playing the role of "sage-on-the-stage"; In this situation students are merely passive receivers of information instead of active learners. Teamwork, leadership, adapting to roles and responsibilities, exercising empathy, and respecting diverse perspectives vanish from the student experience.
b. the textbook equals the curriculum; Here memorization of content is the primary indicator of academic success. Exercising sound

reasoning, understanding, open-ended problems, complex choices, and the interconnectedness of systems are abandoned. Little worth is given to the ability to frame, analyze and solve problems. New ideas, ambiguity, and creativity are often seen as detractors or time wasters.

c. teachers work alone; When isolation replaces the opportunity to collaborate, share ideas, discuss practice, refine ideas, and maintain ongoing conversation we fail to model exemplary behavior to our students. With an isolated group of staff members present in day to day instruction we deprive students of the chance to see ethical behavior in personal, workplace, and community contexts.
d. technology is often found, but poorly used; Access to a "critical mass" of technology tools is still an issue in many schools, but technology use is often limited to student management tasks, or low level thinking activities – the computer becomes an expensive way to deliver worksheets. Students gain a false impression of the role of media in society.

Some schools have embraced technology as the vehicle to take us from the industrial skills of early education to the cognitive, interpersonal and information skills needed in our new society. Moving from industrial skills to deeper levels of thinking requires a shift in our understanding of the computer's role in learning. It demands a change of thinking about how

computers can and should be used in schools. (Jonassen, 1999; Moersch, 2002). A powerful part of this new thinking is the changing role of the teacher as a technology and learning guide. Moersch's (2002) measure for the teacher's Current Instructional Practice (CIP) is a pointed effort to reflect the need to look beyond the hardware, software, and connectivity as ends in themselves. But even teachers who embrace this broader thinking often struggle to modify their beliefs to match a more constructivist approach.

In a national survey (N=32,560) of K-12 participants Moersch (2003) identified the vast majority of teachers at an Exploration (Level 2), or lower, stage of technology integration. More than 15 percent of teachers were identified as Non-Use (Level 0). A full 29 percent of participants scored at the Exploration Level, making it the most common level attained by teachers who answered the questionnaire. The Exploration level is characterized by a use of technology that supplements the instructional program, or compliments selected multimedia or web-based projects at the lower thinking skill level of knowledge/comprehension. Technology generally reinforces the content that is under investigation. The Exploration classroom is more teacher centered than learner centered, and finds students engaged in lower level thinking and cognitive work. Teachers at the Exploration (Level 2) fall below the target Levels of three through six. These higher levels include a more constructivist learning environment, and include higher order thinking skills as part of the students' routine experience (Moersch, 2003).

Maor (2000) states that developing a constructivist approach to teaching and learning, "influences teachers' classroom practices and, subsequently, helps students to develop higher-order learning skills." (p.308). He believes that experiencing a novel learning environment for their own study can assist teachers in reshaping their beliefs and instructional practices. These new learning environments should support the type of professional study that allows time for collaboration and reflection. (CEO Forum on Education and Technology, 2000; Fullan, 1996; Maor, 2000; McKenzie, 1999; Moersch, 2002; Robb, 2000; Sandholtz, 1997; Sparks & Hirsh, 1997c).

Multiple opportunities for focused reflection are embedded in the process of the digital story. Engaging in reflection while constructing a narrative using digital video editing software will move teachers' ongoing professional learning into a rich, new environment. Introducing this kind of new learning environment for teachers is consistent with Maor's (2000) ideas about transforming the beliefs and practices of teachers in their professional learning communities. New learning environments have the potential to transform beliefs and influence deep change in an organization or system.

The Apple Classrooms of Tomorrow (ACOT) project was an example of a brand new kind of learning environment for both students and teachers (Sandholtz, Ringstaff & Dwyer, 1997). By saturating a learning environment with technology tools and systems of support they were able to create a setting that previously had only been theorized. The new environment

presented teachers with many situations they had never encountered before. In order to deepen their thinking and reflection an intentional network of collaboration was established and nurtured. Tape recorders were used to capture and share teacher's questions and thinking. Electronic journals were established to create periodic chances for reflection. The interaction between teachers, researchers, students, and electronic systems was unlike anything participants had seen or been involved with before. This new, rich environment (and the reflective practice it fostered) was a key element in the transformational change that participants experienced during the ACOT project.

Ricki Goldman-Segall was able to create a new way to consider children's learning with her "Points of Viewing" approach (Goldman-Segall, 1998). Her use of video ethnography was both longitudinal and ubiquitous. The camera eventually faded to the background and readers were able to see the true culture of children's thinking from the inside. Goldman-Segall also linked her printed publication with a dynamic web site as a resource to thrust teachers into a new environment for their ongoing study in relation to her work. Goldman-Segall's work was rich in perspective with the natural outcome of reflection. The reader was presented with many opportunities to be challenged about their own beliefs, and consider the situation from a brand new point. This inherent reflection was an integral part of the powerful environment Goldman-Segall was able to create.

Study groups provide another opportunity for reflection and change. Sarason (1996) points out that during cultural change past practices, what teachers have, or have not done, in the past is not nearly as important as what they can quickly learn to do (p. 291). Creating these small learning communities is vital if risk taking and a true change in practice and culture is the desired outcome (Fullan, 1996; McKenzie, 1999; Sandholtz, Ringstaff & Dwyer, 1997; Saylor & Kehrhahn, 2003).

The findings of Casey and Rakes (2002) speak to the issue of cultural change. Their findings indicate that the longer teachers work with technology, the more comfortable they appear to be with that technology and, therefore, more likely they will be to use it effectively (p.124). The authors draw correlations between the teachers' comfort level and successful technology integration in the classroom. The descriptive study used a quantitative research design to correlate scores from the Stages of Concern Questionnaire with the independent variables of: age; grade level; subject; experience; school description; access to technology, and; amount, type, method, site, and content of technology training within the last year. The study examined the PK-12 teachers' level of concern in relation to staff development and demographic data. In regard to staff development, the study found a strong correlation between higher levels of technology integration and instructional technology training focused on the integration of technology into the curriculum. The demographic data indicated that higher levels of technology integration were

more likely to occur in certain subject areas, and the teachers' length of technology use.

Deficiencies In The Studies

The Partnership for 21st Century Skills has provided a valuable work that drew together some very diverse stakeholders. The report has resulted in a clearer picture of our K-12 system's current gap in the promise of educational technology. We see that students are not receiving the kind of learning experiences that will adequately prepare them for the work of the future, but we find no substantive examination of what professional learning supports are necessary to equip teachers to engage in 21st Century learning with their students.

The Learning for the 21st Century report from the Partnership for 21st Century Skills is comprehensive in its examination of our core curriculum, assessments, 21st century tools, and the context in which our K-12 system operates, but the report lacks any specific examination of how ongoing professional learning influences the integration of technology and learning. A connection to the role of professional learning is found in the final part of the report when the Partnership recommends that schools, "develop a professional development plan for 21st century skills" (Partnership for 21st Century Skills, 2003). The report's Mile Guide recommendations also includes a generalized set of criteria for what the outcomes of quality professional

development look like. No attempt is made to include a plan, or criteria, of what the ongoing nature of creating this kind of learning entails. Learning for the 21st Century does not adequately address the question regarding the type(s) of professional learning that is effective in creating the learning outcomes it recommends for our next generation of students.

The Partnership report also fails to examine student achievement in the context of 21st Century skills. Perhaps the connection to student work was beyond the scope of the report, but the connection to student achievement is a missing component that merits examination. A report that focuses so strongly on the skill needs of our students in the 21st century could benefit considerably from data regarding the achievement gains these skills influence.

Likewise Casey & Rakes examine targeted variables in their study, but fail to include an investigation of student achievement. The variables examined in the study fail to connect the process of integration with either student achievement or professional learning. How do the variables mentioned in the study influence the effective integration of technology and learning? The qualitative examination of the processes, relationships, and influences surrounding these variable is missing from the researcher's study. Participants attitudes would benefit from an exploration in a qualitative design. A need for more in depth study is evident.

Dr. Moersch's work with the LoTi framework represents the findings of interactions with more than 32,000 teachers. This substantial report gives an

accurate picture of the current state of integration across our K-12 system in the United States. An intentional connection to higher order thinking skills, and teacher beliefs and practices makes this study uniquely rich. The LoTi survey however does not make a direct connection to the types of professional learning that are effective in moving teachers to the next level, or to the types of gains in student achievement when they are exposed to learning environments at these higher LoTi levels. What conditions and experiences help move professionals along the LoTi levels? Are there connections between LoTi levels and student achievement? Findings of the quantitative LoTi survey can be extended when these questions are examined with a qualitative design.

While the LoTi Survey is substantial it is arguably small when compared to the longitudinal scope of the Apple Classrooms of Tomorrow (ACOT) study. Years of data collection and analysis have led to substantial findings that have influenced hundreds of explorations in the area of technology and learning. Yet ACOT also fails to address the issues surrounding the student achievement associated with rich technology learning. The notion of a technology-rich learning environment was so new that it is understandable to recognize the omission of student achievement as an integral part of the research design. The ACOT research has provided valuable insights to many areas of technology integration – especially the stages of adoption that a teacher experiences when using technology as a teaching tool. The qualitative design used in the ACOT research can benefit

from an examination of student achievement in a technology-rich learning environment.

Goldman-Segall (1998) examined learning cultures in her investigative work with Points of Viewing Children's Thinking and contributed new insights for educators in K-12 settings. Although Goldman-Segall spent a great deal of time and energy focusing on the student participants her research also made no intentional connection to the student's achievement as a result of technology use. Her approach with a middle school student named Mia examined new learning around the Clayquot Sound project but focused on insights about science and Mia's perception of what the experience might mean for her future study. The example provides insightful observation about the learning that occurred and the change of beliefs and attitudes that resulted, but it never attempts to consider the impact the experience had on Mia's achievement against the learning goals contained in the project (Goldman-Segall, 1998).

The Gap

This case study examines a new way to engage in ongoing professional learning. It attempts to describe a rich learning culture that transcends the one-size-fits-all approach that has failed to produce rich learning, or facilitate reform in our K-12 educational system. It addresses the observation that what everyone appears to want for students – a wide array of

learning opportunities that engage us in experiencing, creating, solving real problems with our own experiences while working with others – is for some reason denied to teachers when they are learners (Sparks & Hirsh, 1997).

This study exchanges workshops and seminars for focused reflection and narrative creation used with study groups to support teachers in their ongoing learning to integrate and embed technology in the core curriculum. Both Jonassen's Mindtools and Moersch's LoTi framework disagree with the notion that learners are passive receptacles for the information that the teacher or instructional media delivers to them. (Jonassen, 1996; Moersch, 2002). Teachers will demonstrate understanding of technology rich learning environments and student centered learning by creating a digital story of their classroom experience. The digital story will be created and delivered using digital video editing software. An interview protocol design will ensure that teachers describe their journey and their students' journey simultaneously as they walk side by side in the classroom. The interview protocol design seeks to bring alignment between teacher learning goals and student performance. This intentionality is designed in response to numerous protocols that focus on either student work or teacher performance, but fail to make significant connections between the two perspectives. Danielson's (1996) work is widely used as a way to examine a learning environment, yet it does little to address the dynamic interaction between teacher and student (or perhaps Learner and learner) that is present in rich learning experiences.

A virtual gallery of digital stories will be created as a resource for ongoing professional study. Multimedia mindtools can facilitate learning on various topics of curriculum and instruction, such as active learning, learner-centered instruction, constructivism, collaborative learning, or meaningful technology integration. (Jonassen, 1996; Kurubacak, 1998; Maor, 2000; Swap, 2001). Teachers' ongoing learning and support will take place in the context of learner-centered, collaborative, settings that value the culture of continuous learning more than any specific innovation or program.

Although others have made persuasive arguments of the benefits associated with reflective practice (Brown, 2000; Herner, 2000; Lieberman, 1995; Robb, 2000; Sparks, 1997c) few have connected reflection with the creation of a narrative (Swap, 2001; Wood, 2000), and a current gap in literature is the connecting of focused reflection with the creation of digital video. How does the process of digital editing force the participant to simultaneously reflect from a new perspective, develop a narrative (create meaning of the events), and communicate that narrative in story form? Discovering connections in the previous question has implications for the design of ongoing professional learning, especially in regard to technology integration.

Researchers have failed to ask teachers for the narrative of their professional growth, especially in the context of the shared experience of learning with their students. In bypassing these two voices research has failed

to explore how traditional methods of staff development have failed. Quantitative designs have identified a failing system, but inadequately explored how the traditional system has failed to produce real transformation or change. A study that examines both teacher and student perspectives can make a valuable contribution. Researchers have failed to ask teachers for the narrative of their professional growth, especially in the context of the shared experience of learning with their students.

This study addresses the need to create new learning environments for professional development. It is a direct shift from the historical, one-size-fits-all design that characterizes the present state of professional development in the educational community. (Harper, Squires, & McDougall, 2000; McKenzie, 1999; Robb, 2000; Sparks & Hirsh 1997c). Attention is given to the need for effective and meaningful integration of technology with higher-level student learning through the use of the Levels of Technology Integration (LoTi) (Appendix A) framework.

To address this gap in understanding I propose to study four teachers as they learn to integrate technology with their students. The study will try to describe what teachers do to help students learn with technology; how and why this learning is effective; and the relationship between the teachers' and students' experiences. The study will help to discover how the often overlooked arena of teacher-student interaction may influence the

transformation of beliefs and practices described in studies like ACOT and LoTi (Fisher, 1996; Moersch, 2003).

Ongoing learning to achieve successful integration requires a shift in a participant's beliefs about teaching and learning (Moersch, 2002). A shift in attitudes and beliefs is complex. It requires time for teachers to collaborate in groups – to discuss, reflect, and refine their practice. Opportunities to reflect on actual teaching episodes are a necessary part of the professional learning teachers engage in.

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Special emphasis is placed on digital video, focused reflection, and narrative. Traditional workshops, and training sessions lack the follow up and support necessary to produce meaningful changes in our schools. Staff development cannot compete with the information overload that exists for today's teaching professionals. The term "staff development" has even become ineffective and several researchers suggest we talk about professional

learning or professional study to better describe the kind of lifelong learning teachers and administrators must engage in (Lambert, 2003; Robb, 2000; Sparks & Hirsh, 1997c). Individual data from the LoTi questionnaire can help participants in their goal setting, possibly leading to a shift in their perception and beliefs of what effective staff development needs to become.

Traditional staff development workshops have asked teachers to become student centered while modeling a teacher centered learning environment. These models have often overlooked the needs of adult learners struggling to implement student centered classrooms. A change in culture is required, but traditional programs are unable to supply the structures and resources for cultural change. The shift of power from teacher to learner is often unsettling (Imel, 1995; McKenzie 1999; Sandholtz, Ringstaff & Dwyer, 1997; U.S. Department of Education [USDE], 1992).

We lack ongoing professional development environments that foster rich student learning in the context of technology integration, constructivism, and culutral change. New environments with unsettling events and innovative learning experiences can shift practice and create meaningful professional study that addresses the technology integration needs of teachers and their students. Our current practices are most often ineffective, and rarely seek to examine the shared learning environment experienced by both teacher and student.

Teachers And Setting

Teachers selected for the study will be appropriate and diverse. Adding more teachers would not contribute anything of significance to the study. Purposive selection from volunteer applicants includes criteria to ensure a diverse and appropriate group of study participants. Every teacher in the K-12 system will receive the invitation to participate in the study. The setting is representative of other regional and national school systems. This particular setting has a history of ongoing learning and a learning culture that allows this unique study to be conducted.

Study Methods

The methods I plan to use (participant observation, videotaping, student and teacher interviews, semantic differential, LoTi survey, and collecting of artifacts) will provide the data needed to answer the research questions. Video provides rich data for the researcher, and will be used by participants as they reflect on their learning. Interviews will be open-ended and will include questions generated from the field observations. Data will be gathered from teachers whose selection was guided by a purposive sampling model.

Analysis will be ongoing and inductive to identify emergent themes, patterns, and questions. Coding and comparison across interviews will retain the context of the data gathered. Two third-party observers will lend perspective and help validate the data collected in the study. Additional

strategies to ensure validation include: triangulation; mixed method design; comparison of findings with existing theory. These methods, and others described earlier, will deal with the main validity threats to the conclusions – bias in the selection of teachers, and self-report bias on the part of the researcher.

The study poses no serious ethical problems. Teachers and students will be anonymous. The researcher has no supervisory authority in any relationships with participants. The invitation ot participate in the study will be afforded to all teachers in the system. The study participants will be purposively selected from those who volunteer.

The LoTi framework has a uniquely strong design due to the inclusion of three specific target areas. Moersch (2002) indicates that the LoTi Questionnaire is organized around the areas of Personal Computer Use (PCU), Current Instructional Practice (CIP), and the Level of Technology Integration (LoTi). It reports findings at eight discrete levels of performance. While many technology integration surveys examine data related to student computer ratio, processor speed, multimedia capability, connectivity, and operating systems the LoTi gets beyond these surface issues to probe the questions related to teacher beliefs and comfort level. This distinction creates a rich framework to link technology use with higher levels of student thinking, and constructivist learning.

This LoTi framework provides a context for both reflection of current practice, and professional goal setting. Participants will examine technology integration in relation to the eight discrete levels of the LoTi framework. Descriptions of the technology-rich environments at the upper levels of the LoTi framework provide valuable models for both teacher and student goal setting. This study will attempt to describe how the LoTi framework is changing the instruction and learning that occurs in participants' classrooms. This study will describe how such a framework makes a difference in ongoing learning for both student and teacher.

Significance Of The Study

All healthy organizations grow (Wheatley, 1994). Ongoing learning, especially learning related to reflection and refining of practice, is a critical part of a healthy systems' growth (Brown, 2000). This study examines new environments to improve learning. Meaningful integration of technology is a key element of this study and successful technology use is key to many types of organizations. Anyone doing training and staff development could benefit from the findings of this study. Brown (2000) considers reflective practitioners a valuable commodity in any organization and this study may reveal new methods to foster the development of reflective workers. Educational institutions will find direct connections to the focus of this study, but non-educational institutions will find valuable information also. This study has

possible implications for any organization that wants to continue to learn and grow.

Purpose of the Study

This case study will investigate how teachers reflect on their learning designs, practices, and student learning through digital storytelling. The case study also seeks to discover how reflection through the creation of digital stories might influence teachers' ongoing learning design and practice. This will not be an intervention study, but the students' learning experience will be explored during the study.

This study will examine the role digital video, narrative and reflection can play in assisting professional development efforts to meaningfully integrate technology with existing core curriculum in a standards framework. A case study design will be used in the Taylor Area School District to investigate the role of reflection and storytelling in voluntary teacher study groups. A protocol to assist teachers will be designed, distributed, and used to help teachers evaluate individual goals that align with the Levels of Technology Integration (LoTi) framework. Teachers will also receive support in the software tools used to create their digital story. The collection, and analysis, of qualitative and quantitative data will help discover elements that are crucial to rich technology integration in rich learning designs.

Ongoing professional learning is a key element in successful implementation of many types of initiatives in the K-12 setting – especially in the area of technology integration. Computers can assist teachers in reaching their individual learning goals while modeling the kind of use that supports higher level thinking in classrooms. Teachers in a district possess varying degrees of comfort in regard to technology use, and comfortable levels of technology use do not immediately equal an understanding of successful integration. Ongoing support for reflection and learning is a necessary component if technology is going to make a difference in student achievement.

This case study will look closely at a program of ongoing learning provided for teachers in the Taylor Area School District. It is important to study the efforts of teachers to implement instruction and assessment that is aligned with the LoTi framework. This case study will likely result in findings that can be applied to a wide range of K-12, higher education, and business settings that design or deliver ongoing professional learning opportunities for their staff members. The study will add to the literature about the salient elements in professional development that aid in high level thinking and practice concerning meaningful technology integration.

Limitations

The participants in this study are limited to selected professional staff members in Taylor, Pennsylvania working in the K-12, public school system. The study will be subject to the following limitations:

1. The study will focus on small study groups exclusively in one school district.
2. The sample may not include representatives from all levels.
3. The length of the study may not be sufficient to see the change in practice that a longitudinal study might reveal.
4. Study groups will be created for the research that are not necessarily the same as the participant's natural social context for ongoing learning. Groups will be assembled from schools across the district.

The long history of teacher leadership, and standards implementation in this district will provide a unique setting for the research. This unique environment may provide unexpected insights into the issues surrounding ongoing learning, and meaningful technology integration. The teacher participants may have higher comfort levels with both change and technology use than teachers in other K-12 settings.

Definition of Terms

Digital narrative (a.k.a. digital story) – a digital video edited by the participant to tell the story of their integration experience. The Interview

Protocol will provide a basic framework for the digital narrative. The student perspective will be included in the teacher's narrative.

Interview Protocol – a series of focused questions in three main areas of learning: Learning Goals, Relevance, and Assessment. The protocol will be used a s the basis for the reflection needed to create the digital narrative.

Technology integration – the practice of creating a learning environment that leverages the unique benefits of computers, peripherals, and digital representation to increase the depth and quality of student work and understanding.

Study groups – collaborative teacher groups that come together in both physical and virtual environments to reflect, discuss, and plan for the ongoing practice of technology integration with their students.

Artifacts – physical and virtual items or symbols created by teachers or students individually or collectively that represent their understanding or experience.

Mindtools – according to Jonassen (1996) computer-based tools and learning environments that have been adapted or developed to function as intellectual partners with the learner in order to engage and facilitate critical thinking and higher order learning (p. 9).

Current Instructional Practices (CIP) – one of the three domains measured by the Levels of Technology Integration (LoTi) online questionnaire. The CIP profile reveals each participant's support for, or implementation of,

instructional practices consistent with a learner-based curriculum design (e.g., learning materials determined by the problem areas under investigation, multiple assessment strategies integrated authentically throughout the curriculum, teacher as co-learner/facilitator, focus on learner-based questions).

Personal Computer Use (PCU) – one of the three domains measured by the Levels of Technology Integration (LoTi) online questionnaire. The PCU profile addresses each participant's comfort and proficiency level with using computers (e.g., troubleshooting sinple hardware problems, using multimedia applications) at home or in the workplace.

LoTi Level – one of the three domains measured by the Levels of Technology Integration (LoTi) online questionnaire. It approximates the degree to which each participant either supports or implements the instructional uses of technology in a classroom setting. It serves as a summary score for the participant to gauge their use of technology for richer learning. There are eight discrete performance levels for this indicator of technology integration.

Summary

We lack ongoing professional development environments that foster rich student learning in the context of technology integration, constructivism, and culutral change. New environments with unsettling events and innovative learning experiences can shift practice and create meaningful

professional study that addresses the technology integration needs of teachers and their students. Our current practices are most often ineffective, and rarely seek to examine the shared learning environment experienced by both teacher and student.

There is a need to redefine how ongoing, professional learning takes place; to examine the roles of technology tools in professional learning communities. Alternatives to simply adding technology to ineffective models of staff development must be considered and explored.

We need to discover how conditions in K-12 systems influence the integration of technology and learning. While studies have addressed some of the conditions surrounding the design of technology integration with core curriculum there is a need for additional research to examine how integration influences student achievement. Few studies have explored the connections to the students' experiences during learning designed to integrate core curriculum and technology.

The intentional exploration of both teacher and student perspectives in a professional learning model that places a high value on reflection and narrative creates a learning environment that mirrors the expectations of the classroom learning environment. The LoTi framework provides the structure for purposeful goal setting and evaluation.

Chapter Two: Review Of Literature

A large body of literature on teachers' professional learning provides the basis for this current study. Four factors seem to have a strong influence on teacher beliefs and practice: professional study groups, systems and change, learning with technology, and the power of narrative. These four areas connect in a complex manner, affecting each other and in the process influence teacher learning.

Study groups in quality professional learning are characterized by the formation of learning communities, development of individualized learning goals, quality time for reflective revision, and connection to the overall goal of increased student achievement. Opportunities for reflection in a supportive environment are especially important when innovation is desired. A one-size-fits-all approach to professional learning is common, but ineffective. Results-driven education, systems thinking, and constructivism are three forces that necessitate new models of ongoing professional learning to be developed and implemented(Sparks & Hirsh, 1997).

Systems thinking is a necessary component of any change effort (Fullan & Hargreaves, 1996; Sparks & Hirsh, 1997; Wheatley, 1994). Well intentioned attempts to provide quality professional learning can have limited impact on practice because they are designed and implemented with little regard to the nature of organizations and systems. We must shift our focus to the natural,

embedded processes that develop whole organizations – and implement learning models that recognize the importance of these processes.

The role of technology in professional learning is often characterized by low level cognitive engagement (CEO Forum, 2000; Doherty & Gabbard, 1998; Fisher, Dwyer & Yocum, 1996; Forcier, 1999; Jonassen, 2002; Kurubacak, 1998; McKenzie, 1999; Moersch, 2002; Sparks, 1998). Teachers are learning new technology skill sets, but failing to gain insight or expertise in the process of connecting technology and rich student learning. Student use of technology often reflects the same low level thinking skills prevalent in ongoing professional learning. Technology use by both students and staff has often failed to demonstrate the active, constructive, collaborative, conversational, reflective, contextualized, complex and intentional environment that characterizes a rich learning environment. Much work is needed to narrow the gap between the promise of educational technology and current practice.

Several theories have been advanced to describe the phenomenon of transformational change. The power of story and narrative has been fairly effective in fostering such change (Goldman-Segall, 1998; Haslam, 2000; Olson, 2000; Schwarz, 2001; Swap, Leonard, Shields & Abrams, 2001; Wood, 2000). It provides a way to examine a problem from a new or unfamiliar perspective and possibly produce a significant shift in the participants' thinking and beliefs. An apparent gap in the literature is the linking of narrative by teacher and student to the use of digital video as a reflective tool to improve teacher

practice. The use of digital video in the reflective story process creates a model that demonstrates high level use of technology in a professional learning environment. It has the potential to capture both the teacher and the student experience in a shared learning community.

Professional Study Groups

Traditional staff development program designs have failed to meet the demanding need of professional learning. Forming study groups with teachers honors the same inquiry-based model that the LoTi framework values as a rich context for integration (Moersch, 2002; Tichenor & Heins, 2000). Participating in a study group for ongoing professional learning is a time-consuming task that can benefit from the addition of technology tools and web-based scaffolding and support afforded in a collaborative, asynchronous environment (Bonk & King, 1998). Technology support in the workplace can be a great asset to productivity and, when well implemented, becomes a transparent, intrinsic support system to accomplish the goals of the organization. (Gery, 1995). Technology support, in current models of professional learning, has been relatively ineffective in producing a change in practice or achievement. The outcome of teachers' ongoing learning should be increased student achievement. New models are needed to facilitate this connection of professional learning, technology tools, and student achievement.

For the purpose of this study it is important to determine the role of mindtools, and reflection, in a collaborative setting for ongoing learning. In order to be considered a mindtool, the technology use must lead to higher levels of thinking by the participant. The types of thinking that qualify include: knowledge construction, reflective thinking, amplified thinking, reorganized thinking, and collaborative thinking (Brown & Duguid, 2000; Fisher, Dwyer & Yocum, 1996; Jonassen, 2000; Kurubacak, 1998; McKenzie, 1999; Robb, 2000).

Ongoing learning with opportunities for reflection in a supportive environment is a necessary opportunity for all staff members if an organization hopes to thrive in the midst of rapid change. A nurturing, supportive environment is especially vital when an innovation such as technology is being implemented. Preparing teachers to integrate technology tools with rich, inquiry-based student learning is a complex process. Teachers must embrace the innovation, discuss its implication during practice, and ultimately engage in creating meaning to use technology tools effectively - at their own pace. (Albion, 2000; Brown, 2000; Bybee & Loucks-Horsley, 2000; Fullan, 1996; Goldsworthy, 2000; Johnson, Schwab & Foa, 1999; Levine, 1999). They must become risk takers.

The National Staff Development Council (NSDC), indicates that differentiating the delivery of ongoing learning is vital – even in our follow-up. Technology can help to facilitate follow-up activities associated with staff development. It can assist the creation of ongoing learning that is personalized

and unique instead of generic. (Sparks, 1998). Individual goal setting by professional staff can help create meaningful learning. A framework must be provided to assist teachers in this most important task. A strong framework will help participants make choices about what they need to learn. (Sparks, 1997b). Working within professional study groups using the interview protocol and the digital story supplies a framework.

The professional study groups and professional goal set by each participant create a context that will nurture ongoing learning. By participating in these professional study groups teachers will create meaning from their experiences. Many researchers support the notion that meaning making is an individual, internal process that is enhanced from a rich social context where it takes place (Gery, 1995; Harper, Squires & McDougall, 2000; Imel, 1995; McKenzie, 1999). Other theorists posit that the social setting is more than merely the incubator for later internalization; they contend that persons, actions, and the world are implicated in all thought, speech, knowing, and learning (Lave & Wenger, 1991).

Situated Learning

Many teaching practices have limited effectiveness because they are designed on the premise that conceptual knowledge can be abstracted from the situations in which it is learned (Brown, Collins, & Duguid, 1989). This raises a legitimate question. How does cognition and ongoing professional

learning occur in formal and informal professional study groups, learning communities, apprenticeships, and communities of practice? Lave & Wenger (1991) use situated learning and the notion of legitimate peripheral participation to address this question. They observe that, "In contrast with learning as internalization, learning as increasing participation in communities of practice concerns the whole person acting in the world." (p. 49). Their research intentionally avoids the context of formal schooling, and in so doing provides a wealth of data to inform the ways we might restructure social environments to facilitate learning for our students and staff. To nurture communities of practice that invite participation is a shift in the way we consider ongoing professional learning. Situated learning not only recognizes the importance of context but goes deeper to acknowledge that in a strong community of practice there is limited observable direct forms of instruction but a great deal of engaging and effective learning (Brown & Duguid 2000; Hung & Nichani, 2002; Lave & Wenger, 1991). To change or improve learning in our school "communities" would involve reorganizing the social practice in these groups.

This kind of thinking represents a tremendous shift from the emphasis on content and testing currently found in many of our national, state, and local educational policies and practices. Herrington and Oliver (2000) remind us that, "Much of the abstract knowledge taught in schools and universities is not retrievable in real-life, problem-solving contexts, because this approach

ignores the interdependence of situation and cognition." (p. 23). Unfortunately, many staff development activities mirror a similar, misguided emphasis on content and implementation of abstract knowledge. The task of staff development leadership and planning involves negotiating the paradox of the delicate balance between mandating communities of practice and nurturing authentic communities that are most often informal, voluntary, and resistant to management.

Systems And Change

While effective staff development is highly personalized, it provides skills and frameworks that may ultimately transform an entire organization. Said another way, it is personal but not private. It is naive to look at the lifelong learning of individuals outside the context of the system they are a part of. (Sparks, 1997c; Wheatley, 1994). Wheatley (1994) points to the new kind of thinking and looking we need to keep in mind. She observes:

> In ways we have never noticed, the whole system manages itself as a total system through natural processes that maintain its integrity. It is critical that we see these processes. It will shift our attention away from the parts, those rusting holdovers from an earlier age of organization, and focus on the deeper, embedded processes that create whole organizations. (p. 118)

Rapid change is evident in the proliferation of computer hardware, but change is a matter for teachers to wrestle with as individuals, and respond to as leaders. (Fullan, 1996; The CEO Forum on Education and Technology, 1999; U.S. Congress, Office of Technology Assessment; 1995). Jamie McKenzie would support the shift from a hardware emphasis to a people emphasis in our technology training. Too little emphasis has been devoted to the task of supporting teachers with a rich supply of teaching strategies and technology integration strategies. Too much emphasis has been placed on the infrastructure – too little emphasis given to ongoing training. (McKenzie, 1999; Sandholtz, Ringstaff, & Dwyer, 1997). Virtual communities could accomplish the vision for ongoing learning that becomes a natural, authentic part of the daily routine. Teachers need time to meet in a collegial setting and refine practice (Fullan, 1996; Sparks, 1997a), and technology integration is a practice that needs to be refined.

Within our system smaller groups will come together to discuss, refine and shape the ways the innovation of technology integration become authentic for us. Brown and Duguid (2000, p.142) refer to these groups as "communities of practice". Effective staff development will nurture the formation of these collegial communities and web-based support systems can help to create virtual communities of practice. (Bonk, 1998; Brown, 2000; Sparks, 1997a; U.S. Congress, Office of Technology Assessment, 1995).

Staff members need to engage in active, hands-on experiences to create meaning for themselves. (Sparks, 1997c). Ironically, "What everyone appears to want for students – a wide array of learning opportunities that engage students in experiencing, creating, and solving real problems, using their own experiences, and working with others – is for some reason denied to teachers when they are learners." (Lieberman, 1995, p. 591). Why can't constructivist philosophy be part of the ongoing professional learning too? Teachers will engage in meaning making as they create their unique digital story.

Learning With Technology

The use of electronic technologies in a supportive, constructivist setting will model the types of learning that are desirable for teachers to facilitate with their students. While technology tools have become widely available in many classrooms their impact on learning, in many instances, has not been significant. (The CEO Forum on Education and Technology, 1999; U.S. Congress, Office of Technology Assessment, 1995). Focused efforts to utilize the advantages of electronic tools in both professional development and classroom practice will narrow the gap between educational technology's promise and our current educational reality. (The CEO Forum on Education and Technology, 1999; U.S. Congress, Office of Technology Assessment, 1995). Hardware and infrastructure are prevalent in may U.S. schools, but a great effort is needed to integrate the use of these technologies in the educational

process. (Greenwood, McCoy, Hoppe, & Ganzert, 1999; The CEO Forum on Education and Technology, 1999; U.S. Congress, Office of Technology Assessment, 1995).

Although the use of educational technologies holds the promise of creating a new way in which we teach and learn, integration can begin with the use of computers to do some of our current operations in a slightly different way. (Mayes, 2002; Papert, 1993). Traditional forms of staff development have failed to provide the necessary framework to create innovation. Sparks and Hirsh (1997c) point to the need to address a new form of staff development. They identify three "irresistible forces" (p. 3), results-driven education, systems thinking and constructivism as causes for our need to address a new paradigm of professional development. It is in this new arena that technology will be investigated as a catalyst for enhancing professional development.

Bonk (1998, p.19) details possible uses for technology tool this way: It is clear that collaborative learning tools can now be used to (a) change the way students and instructors interact, (b) electronically apprentice student learning, (c) enhance teamwork and collaborative learning opportunities (d) build intersubjective or shared experiences (e) facilitate class discussion, and (f) move writing and other literacy activities from solitary events to more active, social learning. If we begin to grapple with some of these electronic learning issues, significant progress will be made. The digital story represents a

fundamental shift from traditional teacher – student interaction. The student walks beside the teacher as the teacher reflects on the alignment of goals, assessments, and student learning.

A collaborative setting requires a change in thinking, and in practice. Setting up a web-based system of support enables participants to consider variable and confront misconceptions. (Collinson, 2000; Harper, 2000). Including quality electronic performance support systems (EPSS) in web-based training will help teachers to reach their professional growth goals instead of struggling with software. (Gery, 1995). Gery's use of EPSS stands in opposition to the findings of Dillon and Gabbard (1998) who report mixed success when using hypertext with a variety of learners. Every school is engaging in change – whether they are prepared for it or not. It is not an option to participate. Either engage in ongoing learning and change, or be swept away by it.

Extensive research by the Apple Classrooms Of Tomorrow (ACOT) team in a longitudinal study found that technology introduced additional stress to already overworked teachers, but these teachers found appropriate ways to use the technology in their teaching. The adoption of technology strategies was closely tied to the teachers' beliefs about learning, about teacher-student roles as learners, and about instructional strategies. (Sandholtz et.al., 1997). The teachers in the ACOT study were transformed.

Staff members can actually be transformed. Especially when the technology tools available are used in new ways (Johnson, Schwab & Foa, 1999). Multiflecting and the digital story provide the opportunity for a teachers' transformation. Reeves (1999) reaches a similar conclusion when he states, "In other words, the real power of interactive learning to improve achievement and performance may only be realized when people actively use computers as cognitive tools rather than simply interact with them as tutors or data repositories." Participant's notions about teaching and learning may change because of new staff development delivery and initiatives. One year may not reveal the extent of the transformations that eventually occur. The ACOT found that replacing old teaching habits took time. (Sandholtz et.al., 1997) They identified five phases of use that will supply initial categorization as I look for themes and patterns in my observations, and data collection. The phases of technology use are categorized as: Entry, Adoption, Adaptation, Appropriation, and Invention (Sandholtz et. al., 1997). As the teacher progresses through higher stages of technology use it gradually creates a more learner centered environment. (Nisan-Nelson, 2001 p.85).

While the ACOT study was expansive in its scope it never pursued the direct connection to student achievement. How did the creation of these technology-rich learning environments impact student learning? The need for additional research is especially pressing when considering the role of staff development in the overall picture. It is vital that teachers are trained to use

the conventions we are trying to implement in an environment that aligns with our expectations of student learning. “From a constructivist perspective, it is critical that teachers model appropriate behavior, guide student activities, and provide various forms of examples rather than use common instructional practices that emphasize telling and directing.” (Sparks, 1997c. p. 9).

The CEO Forum on Education and Technology issues an annual assessment of the nation's progress toward integrating technology into American classrooms. Their conclusions point directly to the need for additional study and research. “Teachers today need ongoing exposure to technology and the resources required to turn the possibilities technology offers into real results for students at all levels and in all disciplines.” Additionally, “What teachers really need is in-depth, sustained assistance as they work to integrate computer use into the curriculum and confront the tension between traditional methods of instruction and new pedagogic methods that make extensive use of technology.” (“The CEO Forum,” 1999) My study will provide valuable insight into the experiences of providing in-depth, sustained assistance, and multiple opportunities for reflection, for teachers and staff. Editing the digital story offers a unique perspective where a teacher can look at themselves working with their students from the outside in.

Jonassen (2002) identifies 8 characteristics of constructivist learning environments as: active, constructive, collaborative, conversational, reflective, contextualized, complex, and intentional. Attainment of individual teacher

goals will be evaluated by the student work produced when they are engaged in constructivist learning environments. Teachers will design rich learning environments in the context of their study groups. These groups are effective in initiating change, and model the type of belief and behavior that can be transferred to the learning environments provided for students (Fisher, Dwyer & Yocum, 1996; Herner & Higgins, 2000; Jonassen, 1999; McKenzie, 1999; Petraglia, 1998; Tichner & Heins, 2000). Another benefit of study groups is the ability to apply the learning gained in their interaction directly to the everyday practice of the staff members (Brown & Duguid, 2000; Herrington & Oliver, 1999). Study groups will be the first place that a digital story is shared.

Making everyday practice consistent with constructivist theory and rich integration is a difficult task that schools have not accomplished with much success. A comprehensive Education Week study published in 2001 found that "50% of students with computer access at school said they use school computers one hour or less a week." (p.47). Additionally, a full 56% of students said they've learned most of what they know about computers at home.

Power Of Narrative

Narrative is the tool we use to make sense of our experience. The link between our identity and our story reinforces the power of narratives to produce personal transformation and change (Clark, 2001; Olson, 2000).

Ironically the relatively private endeavor of narrative creation includes an "automatic" social context. Clark (2000) indicates that our stories "are shaped by the culture in which they are embedded and through which they are given meaning" (p. 88). Good stories matter to the teller and the audience, they provoke inquiry. Teachers creating a narrative will reflect on their recent experience and enrich their own understanding of learning events. When the narrative is shared with other teachers an extended learning community will begin to examine, and make sense of, their daily practice.

Educational technologists can talk about integration persistently, but integration will not happen until teachers develop philosophies and techniques for themselves from their own experience (Haslam, 2002; Schwarz, 2001). Creating and communicating narratives will enable the development of philosophies and techniques that sustain technology integration. Providing a framework for teacher's exploration will enhance the effectiveness of the integration exploration (Sandholtz, Ringstaff, & Dwyer, 1997; Sparks & Hirsch, 1997c). A larger framework allows for individual reflection and knowledge creation to be connected to targeted goals of the organization.

The digital story interview protocol provides a framework that expands the notion of a student's role in the planning, delivery, and redesign of technology-rich learning experiences. The digital story fills a role similar to the Unit Of Practice (UOP) model established in the ACOT research study (Sandholtz, Ringstaff & Dwyer, 1997). The six components of the UOP

framework are: Standards; Tasks; Interactions; Tools; Situations; and Assessments. Teams of teachers using this framework were able to envision the components of a learning activity as one integrated whole. In a similar way the digital story interview protocol will keep the investigation of technology integration connected to the larger picture of enriching student learning.

The creation of a narrative proves to be a powerful aspect of meaning making. Roussos, et al. studies a virtual garden that records a continuous narrative. The analogy given in summary is children, "...in a real garden can learn to plant, in the virtual garden they can learn how to think about plants." (p. 63). The thinking is accomplished most powerfully when it is examined with reflection, and communicated to others through story. In this study the process of editing a digital video forces the editor to consider the narrative being constructed. The connection to the digital story interview protocol ensures that the digital stories become a type of text for improving practice. Sharing the videos together will build a community of learners that is focused on improving practice. The narrative links personal and professional aspects together in a more holistic experience (Haslam, 2002; Olson, 2000; Roussos, 1997; Wood, 2000). This is the rich environment that facilitates transformation.

Literature Summary

Several themes have emerged from the review of literature. Teachers need time, and support, to meet in collegial, collaborative settings to refine practice. Strong communities of practice recognize that situation and cognition are interdependent.

Meaningful technology integration is accompanied by a shift to a more student centered learning environment. This shift often involves a change in the instructor's beliefs about teaching and learning.

Technology integration should engage learners in tasks that result in knowledge construction, reflective thinking, amplified thinking, reorganized thinking, or collaborative thinking.

Traditional practices in K-12 staff development are not effective for the ongoing learning associated with technology and change. Targeted, authentic, long-term efforts are needed to achieve quality results.

The power of story/narrative to transform beliefs and practices is substantial. Narrative includes a point of view and the reflection associated with the development of a perspective can lead to change in beliefs.

Sandholtz (1997) observes, "Having teachers focus on a teaching episode that has already been implemented, rather than having them develop an entirely new lesson, decreases teacher anxiety about risk taking and gives teachers a more manageable starting point for thinking about technology integration." (p. 123). Using an existing teaching episode gives a teacher the chance to reflect on their practice. Capturing that same episode with digital

video allows the unique opportunity to reflect again while editing the videotape to create a personal narrative - their digital story.

Jonassen's (2000) mindtools can enhance the creation of materials for the Tasks and Tools components of the UOP framework. But more importantly, it can enrich the learning task and, along with the UOP framework, provide a rich, integrated whole where the use of technology is embedded in a meaningful learning experience.

Chapter Three: Methodology

Introduction

Cresswell (2003) pointed out quite clearly that, "qualitative procedures stand in stark contrast to the methods of quantitative research." (p.179). Solid characteristics, however, have been advanced for qualitative research by Rossman & Rallis (1998) that capture both the traditional perspective and the self-reflective perspectives of qualitative inquiry. Eight characteristics in particular are worthy of discussion as they relate to this study (Cresswell, 2003; Rossman & Rallis, 1998). Three characteristics relate to the qualities of qualitative research and four others relate to the role of the qualitative researcher.

Qualitative research occured in the natural setting. Unlike classic experimental design, the natural setting was valued as the preferred location for the study. The researcher traveled to the site of the participant(s) to conduct the research. One advantage of conducting research in the natural setting is the deeper level of detail the researcher was able to establish concerning both the individual and place. Another advantage was the researcher became highly involved in the actual experiences of the participant (Creswell, 2003). This study benefited from both advantages mentioned as the researcher became a participant observer in the classrooms of the participants. The researcher was immersed in the environment the participants experienced and this made richer data collection possible.

Qualitative research used multiple methods of data collection that were both interactive and humanistic. Participants were actively involved in the data collection process as the researcher sought to build both rapport and credibility with the individuals in the study. There was a sensitivity toward participants in the study and the site was not disturbed any more than was necessary for the study to be conducted. Traditional data collection methods using open-ended interviews, observations and documents were expanded to include a wide array of materials such as sounds, motion video, emails, scrapbooks, student work, and other emerging forms. Data collection involved text, data, and images (Creswell, 2003). This study employed multiple methods of data collection including an emerging use of motion video. Artifacts of learning from both students and teachers were used as data sources for analysis. Data collection and data analysis were enhanced because of the authentic relationships that were established between the researcher and the individual participants.

Qualitative research was emergent, not tightly preconfigured. The implications of this characteristic were far reaching. During the course of the investigation the research questions changed and were refined as the researcher learned what to ask and to whom it should be asked. The data collection process changed as opportunities emerged or disappeared for data collection. New sites of data collection became available. Even the theory or general pattern of understanding emerged beginning with initial codes,

developed into broad themes, and shifted to grounded theory or broad interpretation. This characteristic of a research model that is always unfolding made it difficult to prefigure research tightly at the proposal stage (Creswell, 2003). This study was intentional about fighting off the tendency toward premature closure concerning data collection and analysis. Knowing that the research model allowed for, even expected, the understanding to emerge during the research process added a great deal of complexity to the study. It related directly to the next characteristic.

Qualitative research was fundamentally interpretive. The researcher made an interpretation of the data. The researcher filtered the data through a personal lens that is situated in a particular sociopolitical and historical moment in time. The personal interpretation brought to the qualitative data analysis could not be escaped (Creswell, 2003). The interpretive characteristic influenced this study in many areas including descriptions of individuals and settings, analysis of data themes or categories, and in the interpretations and conclusions of the study. Conclusions about the personal and theoretical meaning, lessons learned, and further questions to be asked were influenced by the interpretation of the researcher. The next four characteristics spoke directly to the role of the researcher conducting research in a qualitative model.

The qualitative researcher viewed social phenomena holistically. This is why qualitative studies appeared as broad views rather than micro-analyses. The more complex, interactive, and encompassing the narrative, the better the

qualitative study (Creswell, 2003). This study intended to include a highly interactive narrative that engaged both students, teachers, and researcher around a complex and authentic process of integrating technology for rich learning. The researcher intended to use visual models and examples to illustrate the holistic picture of the study. The intentionality of including student and teacher perspectives related directly to the holistic nature of the learning process. The phenomena could be understood in isolation of each other. The researcher made meaning from this broad interaction and context.

The qualitative researcher systematically reflected on who he was in the inquiry and was sensitive to his personal biography and how it shaped the study. The introspection and acknowledgement of biases, values, and interests typified the qualitative research found today. The personal-self became inseparable from the researcher-self (Creswell, 2003). This study agreed that all inquiry was laden with values. Statements concerning the personal reflection of the researcher appeared in statements concerning the role of the researcher, or were intentionally embedded in sections throughout the study. The lens of the researcher was addressed and made evident to the participants and the reader of the study.

The qualitative researcher used complex reasoning that was multifaceted, repetitious, and simultaneous. While this reasoning was largely inductive, both inductive and deductive processes were at work (Creswell, 2003). This study expected a certain amount of recursive processing. Data

collection and analysis led to problem reformation and back again. The fact that data was collected, analyzed and written about simultaneously added to the repetitious nature of the inquiry. This kind of complexity was a necessary component when researching a complex process with many levels of relationships and experiences at work.

The qualitative researcher adopted and used one or more strategies of inquiry as a guide for the procedures in the qualitative study (Creswell, 2003). In this study the process of designing rich learning environments with technology were explored using the case study method. Creswell (2003) recommended the case study model as an effective strategy to explore processes, activities, and events. Case study was an established strategy for research that has been widely used in the social sciences.

Study Groups

There was great promise in the use of study groups that take advantage of technologies for shared communication (Jonassen, Peck & Wilson, 1999). Many of the examples described by Jonassen, Peck & Wilson (1999) extended the sphere of a groups' influence to a worldwide audience. Principles of technology tools to support shared learning applied to a group with a fixed set of participants. The type of group found in this study was more accurately described as a community of practice (Brown & Duguid, 2000; Jonassen, Peck & Wilson, 1999). The social context for the groups' knowledge creation and

interaction was both virtual and face-to-face. An electronic system for email and bulletin board exchanges was created with resources available online at www.crteacher.com. The system provided opportunities for one-alone, one-to-one, and one-to-many communication levels (Jonassen, Peck & Wilson, 1999). The study group also had scheduled face-to-face meetings.

As formal and informal study group session took place the researcher had additional opportunities to gather data. These sessions included opportunities for participants to respond to predetermined questions, and included ample time for participants to share their stories about the learning processes they were currently engaging in. Face-to-face meetings were held on the school district site. I videotaped some of the study group sessions. Electronic documents created during face-to-face sessions were archived whenever possible to be used as artifacts for collection and analysis, and to serve as an archived record of learning for participants to use during the process of integration with their curriculum. These electronic resources were used by participants while they planned for instruction, assessment, technology connections, and their ongoing learning (Jonassen, Peck & Wilson, 1999).

The sessions included an intentional opportunity for reflection about the successes and struggles associated with the planning and execution of rich learning experiences using technology. The written and spoken comments by

participants at the study sessions helped inform the context, similarity and difference, and relevance of participants' experiences.

Type Of Research Design

The study investigated the following question: What kinds of ongoing learning appear to facilitate the integration of technology with core curriculum? Related questions included: 1. How can the Levels of Technology Integration (LoTi) framework assist in the process of ongoing learning and goal setting? 2. How does the construction of a digital story affect the meaningful integration of technology with student learning? 3.What kinds of social contexts assist in the construction of richer learning environments for students? 4. How can we explain the limited integration of technology with core curriculum despite generous access to technology resources?

This case study examined a new way to engage in ongoing professional learning. It attempted to describe a rich learning culture that transcended the one-size-fits-all approach that has failed to produce rich learning, or facilitate reform in our K-12 educational system. It addressed the observation that what everyone appears to want for students – a wide array of learning opportunities that engage us in experiencing, creating, solving real problems with our own experiences while working with others – is for some reason denied to teachers when they are learners (Sparks & Hirsh, 1997).

Qualitative research sought answers in the real world. Rossman & Rallis (1998) point out that qualitative research has two unique features: the researcher is the means through which the study is conducted; and the purpose is learning about some facet of the societal world. Both of these characteristics placed the learner at the center of meaning making. Qualitative research aligned with constructivist theory in this way. Qualitative researchers were learners – transferring knowledge into meaning. This exploratory study was especially well suited for the qualitative design for several reasons.

First the context of the problem was very important. The issues surrounding meaningful technology integration were varied and complex. The problem defied being reduced to several variables and quantitatively measured. Exploring the thinking that both teacher and students underwent as they learned together was a relatively unique approach that sought to understand the design of planning for the implementation of technology more fully. The interview protocol helped explore the problem and resulted in data that was qualitative in nature.

The qualitative portion of the mixed method design coincided with the use of description, narrative, and storytelling (Eisner, 1998). Reality was determined by the multiple perspectives discovered by participants in the study. Reality was discovered through the eyes of the participants who were living the shared experience with the observer. Eisner (1998) argued that the

knowledge of the empirical world is essentially qualitative; we write, draw, sing, dance, tell stories and create artifacts to represent it.

The process of the interview protocol helped participants reflect on their experience, and created their unique description and story. During the creation of the narratives and artifacts they were essentially representing their empirical knowledge. Collecting and analyzing narratives and artifacts from teacher and student was a central part of the research design for this study.

Second the mixed methods design allowed the rich, multidisciplinary approach that drew on the best practices from the fields of anthropology, psychology, sociology, and education. Eisner (1998) noted that qualitative inquiry is not the property of any one discipline (p. 28). Many social sciences used the case study approach to conduct research. This study could not take place outside of the culture, hopes, fears, relationships, climate, and institution that defined the learning community participants' notions of technology integration with their routine practice. The concept of technology integration was immature due to a relative lack of theory and previous research.

Third the use of a primarily qualitative design, and a case study format in particular, aligned with modern trends in educational research (Creswell, 2003). The social nature of learning and multiple variables that contributed to student success and failure have led many educational researchers to choose qualitative research designs. The problem in this study demanded a rich, detailed description to create understanding.

Fourth a focus of the study sought to explore the role of reflection in technology integration. This study sought to understand the transformation that occurred when there was purposeful and intentional reflection from multiple perspectives – including a description of that reflection through a user-created narrative. The protocol used in this study examined the teacher and student experience simultaneously. Both teacher and student perspectives were included in the digital narrative.

The primary source of quantitative data gathered in this mixed research design was the Levels of Technology Implementation (LoTi) online questionnaire. LoTi has proven to be a strong, unique framework that linked the technology use in a classroom with the teacher's Level of Technology Implementation (LoTi), Personal Computer Use (PCU), and Current Instructional Practice (CIP).

LoTi was unique in twp respects 1) its connection to multiple measures to describe and assess technology implementation and 2) its use with tens of thousands on a national scale. The LoTi levels were created in relation to the research based Levels of Technology Use that came from the ACOT studies.

The Researcher's Role

As a participant observer I engaged in learning with my participants, not distancing myself from that interaction (Creswell, 1998; Rossman & Rallis, 1998; Wiersma, 2000). The research was a case study design using qualitative

and quantitative methods. The goal of this study was to facilitate change through the use of the information collected during the study. A successful study resulted in improved understanding and influence concerning the creation of technology rich learning environments for staff and students in the Taylor Area School District.

This study was interpretive research. My biases, judgments, and values were stated explicitly in the research report (Cresswell, 1994). These conditions, and past experiences, influenced my interpretation and narrative. Likewise, my participants had biased perspectives as they created their stories. Their past experiences shaped and informed their creation of meaning. They added to the richness of the participant observer role. Specifically my role at Taylor included experiences that provided me with familiarity with the topic, the setting, and the participants.

I had been active in the facilitation of technology integration since the late 1980's. One of my first significant projects was the creation of a set of installation disks that automatically configured an Apple Macintosh™ computer to access the graphical interface of the World Wide Web through a Point to Point protocol (PPP) connection. This allowed teachers to easily move beyond the confines of the text-only Internet experience. My experiences from that point on continued to focus on creating solutions for the teachers and students who saw the power of enhancing and expanding learning with the help of targeted technologies.

Subsequent positions in the Taylor District allowed me to help teachers, in a coaching model, as they designed rich learning environments. Many of theses designs included the use of technology. One successful CD-ROM based tool I helped to design and pilot aligned an Oral History project with the Pennsylvania State Standards for Reading, Writing, Speaking, and Listening (Appendix B). Another technology solution developed to support ongoing learning was the Staff Development web site I initially created for our professional staff (Appendix C). The site included multimedia resources to facilitate the implementation of standards and established the connection of technology with learning.

Designing and facilitating ongoing learning with our professional staff provided insights to the problems of meaningful technology integration, and discoveries about the nature of both adult and student learning. Working with both large and small groups of students and teachers afforded the researcher many opportunities to reflect on the problem targeted in this study.

I was involved in fieldwork. My role included going to on site locations to observe and record both teacher and student behavior in a natural setting. I was primarily interested in how these teachers and students made meaning of their shared experiences. My thinking and reporting was shaped from details gained in these observations of learning. I described the process, meaning, and understanding participants gained through my written report and the digital stories authored by participants.

Mrs. Gail Ryan, Director of Elementary Education at Taylor Area School District, and Donna Huff, Principal, were outside observers for the study. Both had extensive classroom experience. Mrs. Ryan has been a classroom teacher, building principal, and served as a cabinet-level administrator in the district during the study. She had a broad knowledge of instructional strategies and recognized strong, nurturing learning environments in the classroom. As the evaluator during many formal and informal observations she brought a strong eye to the study and was an asset as the researcher collected and analyzed data.

Mrs. Huff had been a classroom teacher, a district-level coach for all K-5 staff members in the district, and had just begun her new role of elementary principal during the research study. She also participated in the National Staff Development Council Academy class of 2006. Intuitive recognition of quality learning bolstered by a strong underpinning of theoretical frameworks allowed Donna to bring a strong background to this study. She served as highly qualified third-party resource as the researcher collected and analyzed data.

Context For The Study

Taylor Area School District was one of the 501 districts in the state. It was a suburban district located in southeastern Pennsylvania midway between Philadelphia and Allentown. The Taylor Area School District

included an area of 49 square miles in Upper Montgomery County and was the largest school district, in square miles, in the county. Within its boundaries were six municipalities: the two boroughs of Taylor and Telford and the four townships of Franconia, Lower Salford, Upper Salford and Salford. It was one of 22 locally governed public school systems supported by the Montgomery County Intermediate Unit. The K-12 system included seven elementary schools, one middle school, one junior high school, and one senior high school. The professional staff included approximately 32 administrators, and 480 teachers. There were approximately 6700 students in grades K-12. Montgomery County, like other suburban counties in Pennsylvania, was experiencing tremendous growth. The Pennsylvania Economy League (2004) reported that between the years of 1990 and 2000 the overall population of the Taylor Area School District increased from 33,089 to 41,213 for an overall increase of 27.6%.

The current population of the school district was 42,602, with the median age of 37 years. The percentage of adults who held at least a Bachelor's Degree was 39%. The median household income in the Taylor Area School District was $74,879 (Standard & Poors, 2003). The median cost for a home in 2000 was $153,900. Businesses in the immediate area included several internationally recognized drug companies, a few international food processing and packaging facilities, one of the largest home builders in the United States, and a large insurance company. Socio-economic characteristics

of district families ranged considerably. The student population was predominantly Caucasian. The racial/ethnic characteristic of the student population in the district included approximately 90% Caucasian, and 10% Asian, Hispanic, Black, and other minority students. The area was initially settled by many members of the Mennonite tradition, and even amidst rapid change the influence of that founding group remained.

Achievement data for the Taylor Area School District included an average SAT score for juniors and seniors of 524 points in Math and 545 points in Verbal. In the 2002-2003 academic year 408 students were enrolled in Advanced Placement courses. The percentage of students who scored at the Proficient or Advanced levels on the 2003 Pennsylvania System for School Assessment (PSSA) tests were:

Table 1 – Percentage of students at proficient or advanced levels

Grade Level	Reading	Math	Writing
5	74.2%	82.5%	NA
6	NA	NA	76.8%
8	71.3%	56.6%	NA
9	NA	NA	80.8%
11	68.7%	59.6%	81.4%

Relationships previously described helped the researcher secure access to participants, facilities, and any necessary materials. This access was assured

by the Directors of Education and the Superintendent. The research was conducted in the Taylor Area School District in Taylor, Pennsylvania.

Taylor School District had a recent history of innovation and risk taking. In the early 1990s it was a model for the creation and implementation of standards-based instruction before the concept became a national trend. Taylor was able to design district standards and rewrite dozens of planned courses to align with the newly created frameworks. A CD-ROM tool was instrumental in the development of district standards and the planned course design process. The *Planned Course CD-ROM* was designed by Dr. Marion Dugan for Taylor Area School District and was distributed to key curriculum leaders and teachers at all levels. This CD-ROM helped teachers write dozens of courses that aligned with district standards. Using technology tools in the support of teacher learning was an innovation that helped establish the climate of professional learning in the district. The *Planned Course CD-ROM* was used by other districts to support the creation of curricula that aligned learning goals with relevant standards and meaningful assessment.

The success of the *Planned Course CD-ROM* was followed by the development of several other CD-ROM tools for ongoing learning including: *The Oral History Project*, and *Designing Standards-Based Reading Curriculum Grades K-1*2. Both these CD-ROM tools were intentional to align Pennsylvania standards in reading, writing, speaking, and listening with supports for staff members in all curricular areas. The Oral History Project CD-ROM was

designed to provide support for both students and teachers. It established a virtual scaffolding for teachers learning how to develop learning experiences that aligned to standards while simultaneously providing resources for student research and project work.

The *Oral History Project* and *Reading* CD-ROMs were eventually distributed state-wide with the release of the Pennsylvania Literacy Framework by the Pennsylvania Department of Education in 2000. Taylor Area School District demonstrated a willingness to risk and innovate in attempts to improve the quality and efficacy of ongoing professional learning for all members of the organization.

In 1998 Taylor demonstrated its risk taking personality by requiring a group of products from every professional employee to demonstrate their proficiency with selected technology tools. This project-based approach was much different from the checklist style proficiency model many districts and third party vendors were engaging in at that time. It honored the prior knowledge of staff members, and foreshadowed a system wide shift from passive, seat-time learning to an active, performance-based model of professional learning.

Yearly professional growth goals were still in place at the time of the research study. Professional staff members set a learning goal, learned together in study groups to achieve their goal, and demonstrated their

learning by reporting out to small groups in end of year faculty meetings. Reports included artifacts or other products created by the learners.

Past practices have helped establish a climate of ongoing professional learning in the organization. Staff members were accustomed to access to digital resources to assist them in their personal learning. Previous CDs mentioned were augmented by CDs focused on Reading, Writing and the Pennsylvania Literacy Framework. Ongoing professional learning was coordinated through a web based subscription service known as MyLearningPlan.com (MLP). Summer sessions, study groups, inservice opportunities, flex days, mentoring/induction, assorted workshops, and hours for continued state certification were all consolidated at this site. MyLearningPlan.com was preceded by digital resources made available through a staff development web site mentioned earlier in this chapter.

Participants

The study focused on four teachers who volunteered to participate in the study. The teachers represented elementary, middle, and secondary levels. Two teachers came from grades K-5, one from grades 6-9, and one from grades 10-12. They came from several curricular areas. A broad range of technology skill levels was also represented in the four participants.

Experienced teachers were included (10+ years of teaching) as were teachers new to the profession (less than 5 years of teaching experience).

Including a range of participants helped me gain insights into problems and challenges facing teachers at various stages in their professional careers. Every teacher in the district was invited to participate. The four teachers in the research study were chosen from among those who volunteered to participate.

Invitation to participate was sent via the district wide email system, FirstClass mail. Four teachers were chosen to participate in the study from those who volunteered. A purposive sample of participants was chosen based on their alignment with the following criteria considered to be an ideal sample:

- both new and experienced teachers
- teachers from different grade levels
- teachers from different curricular disciplines
- teachers who have demonstrated an interest in the integration of technology, or have chosen integration as a professional goal
- teachers with varying degrees of technology integration skills and comfort levels, but proficiency with the basic operation of their computer
- teachers who reflected on their practice and their students' achievement
- teachers who have access to an internet-connected computer at home

Participants engaged in ongoing learning they chose through their selection of professional growth goal aligned with the Levels of Technology

Integration (LoTi) framework. Participants had access to the Internet at home to participate in electronic journals, and take full advantage of the scaffolding in place for their integration learning. Volunteers were selected using purposive sampling.

Data Collection

An invitation to participate was distributed via email and inter-department mailing to all professional staff members. The researcher purposefully selected participant volunteers to answer the research question. No attempt was made to randomly select participants.

Data were collected in a variety of ways including: LoTi Technology Use Profile, technology lesson plans they created, electronic journals, interviews, field observations, videotaping, artifacts and their digital story project.

Table 2 – Alignment of research questions and methods

	LoTi Survey	Lesson Plan	Journal	Interview	Observation	Digital Story	Artifacts
What kinds of ongoing learning appear to facilitate the integration of Technology with core curriculum?		X	X	X	X	X	X
How can the Levels of Technology Integration (LoTi) framework assist in the process of ongoing learning and goal setting?	X	X	X	X	X	X	X
How does the construction of a digital story affect the meaningful integration of technology with student learning?			X	X	X	X	X
What kinds of social contexts assist in the construction of richer learning environments for students?	X		X	X	X	X	X
How can we explain the limited integration of technology with core curriculum despite generous access to technology resources?	X		X	X	X	X	X

LoTi Technology Use Profile

Dr. Christopher Moersch incorporated the work of the Concerns-Based Adoption Model (Hall & Loucks, 1979; Hall, Wallace & Dossett, 1973) and the ACOT (Apple Classrooms of Tomorrow, 1995) research with his own observations of hundreds of classrooms to design a conceptual model that focused more on assessment and instruction and less on technology as an end in itself.

The LoTi Technology Use Profile was designed to explore the role of technology use in the classroom by measuring three key areas: (1) classroom teachers' Level of Technology Implementation (LoTi), (2) Personal Computer Use (PCU), and (3) Current Instructional Practices (CIP). The LoTi Profile portion assesses classroom teachers' current Level of Technology Implementation based on the Level of Technology Implementation (LoTi) Framework developed by Dr. Moersch; the PCU Profile portion assesses classroom teachers' comfort and skill level with using a personal computer; and the CIP Profile portion assesses classroom teachers' current instructional practices relating to a subject-matter versus a learner-based curriculum approach. The LoTi framework has been used nationally and internationally to assess tens of thousands of classroom teachers' level of technology use. Moersch (2001) indicated that in a study of K-6 classroom teachers (N=237) in 12 elementary schools completing the LoTi survey reliability calculations using Cronbach's alpha indicated that the LoTi instrument demonstrated

internal consistency on LoTi Level, Personal Computer Use, and Current Instructional Practice components (r = .7427, .8148, and .7353 respectively).

The survey was a series of statements that teachers responded to on a seven point Likert Scale of “not true” to “very true”. Participants read the statements and identified if these statements were true, or not true, of them as of the current point in their teaching experience. Fifty survey items were categorized in four areas of technology use: instructional purpose, active student learning, personal skill development, and curriculum beliefs and goals. Ten questions addressed the instructional purposes of technology; ten questions focused on how technology would be used with students; twenty questions assessed teachers personal technological skill growth; and ten questions analyzed teachers curriculum beliefs and goals. The first three categories related directly to technology. The fourth category consisted of more global questions to identify the teachers’ beliefs about curriculum and instruction. This fourth category was used to identify teachers’ beliefs about factors influencing curriculum development and the role that students should play in the ongoing development of curriculum (Heafner & White, 2003).

The LoTi survey resulted in Technology Use Profiles that provided schools with an action plan to raise their current level of technology implementation in the classroom. The action plans enabled school systems to track their progress toward reaching the national "Target Technology" level. The action plans: provided schools with a data-driven approach to

instructional computing decision-making at the site level; created an accountability mechanism for schools to justify added funding for instructional computing; empowered school systems to assess changes in classroom teacher's instructional practices related to the use of computers; allowed school systems to effectively manage the efficient use of district, state, and federal funds for the procurement of hardware, software, and staff development; and consolidated staff development offerings for instruction, technology, and assessment.

Lesson Plans

Technology lesson plans that participants created were compared to the criteria named in the eight discrete Levels LoTi framework. Learning goals, instruction and relevance were compared with their alignment to the LoTi framework. The lesson plan was an artifact that represented the teachers' beliefs and biases about their use of technology in learning. By collecting lesson plans at different times throughout the study the researcher was able to see a shift in thinking, planning, and/or beliefs about student-centered learning and the role of technology. Study group time included the opportunity to discuss lesson plans and identify how specific plans aligned with the eight levels of the LoTi framework. A lesson plan format adapted from the Apple Learning Interchange web site was available for participants to use for their planning (Appendix D). The format of this lesson plan aligned with the major components of the Unit of Practice model that was developed

and used during the Apple Classrooms of Tomorrow (1995) research study. Teachers had access to a electronic version of this lesson plan model in order to facilitate two key goals: (a) lesson sharing and revision among participants, and (b) central data collection for analysis and interpretation. Since the study site offered remote access from any internet connected computer the participants were able to use a stand-alone, electronic version of the lesson plan when they were not on-site.

Electronic Journal And Listserv

Each teacher participant was also asked to keep a double-entry learning journal. The journal included both observations and reflections. Additional prompts for journal writing were given on the www.crteacher.com web site. Journals entries were discussed at study group sessions. Participants were asked to respond to the prompts, but were free to make as many journal entries as they wanted during the course of the study.

Electronic data collection on the listserv was accomplished in three ways: (a) A forum was established for the teacher participants using resources at www.crteacher.com to establish the group. Each participant was expected to read all and respond to many of the messages posted on the forums. Responses were expected in a timely manner. (b) Two or three chat sessions were scheduled during the study. These sessions were focused on a topic generated from the forum or informal coaching interactions. The sessions

were scheduled for weekday evenings so participants were using their internet connection at home to participate. (b) Online surveys were included. Web-based data collection were used to allow survey results to be easily imported into MS Excel for analysis. This quantitative data strengthened the research design. Surveys were created and distributed using the web-based services available through www.crteacher.com.

Interviews

Traditional types of interviews included informal conversational interviews, guided interviews, and standardized open-ended interviews (Rossman & Rallis, 1998). Conversational interviews were recorded in field notes and recognized primarily as part of the social flow encountered at the research site. Guided interviews were typically designed to elicit the participant's worldview. The participant did most of the talking while the researcher posed open-ended questions and then raised further questions or requests for elaboration based on participants' responses. The researcher was capturing the participant's perspective on the phenomenon as it unfolded. Standardized open-ended interviews were tightly prefigured and included fixed questions that were asked of each participant in the same order. The open-ended nature of the questions allowed the participant to respond freely.

Discussion by Rossman & Rallis (1998) expanded the types of interviews that were considered including dialogic interviews. The dialogic interview was a true conversation. Researcher and participant developed a

more complex understanding of the phenomenon, or process together. There was mutual give and take, and the talk time was more balanced between participant and researcher.

This study used the guided interview and dialogic interview to collect data. Interviews were a way to get rich, detailed data about how participants viewed their world and their experiences. Because interviews relied heavily on the personal involvement of both parties limitations were inherent. The cooperation of the participants and interpersonal skills of the researcher were critical aspects of this type of data collection. Also, the interviewer gathered volumes of data, but the data were time-consuming to analyze (Rossman & Rallis, 1998). For these reasons the interviews used in the study were supplemented by other types of data collection, including some quantitative data, to assist in the analysis of data. Including interviews with other collection methods helped triangulate data collection and analysis. Interview were a method to "go deeper" into the areas of data that arose during the course of the study.

Some interviews conducted with participants followed the teacher/student interview protocol. An interview protocol with an emphasis on open-ended questions allowed participants to comment on their previous learning experiences and professional growth. Student perspective were also gathered using the interview protocol. The alignment of teacher and student data helped to gather data related directly to the experiences surrounding

student achievement during the study. Targeted questions to address the learning goals, quality of student work, use of feedback for improved performance, and depth of enduring understanding provided a rich gathering of data to interpret for student achievement findings.

Interviews were conducted with each teacher participant at the beginning of the study. An exit interview was conducted with teacher participants in a small group session. Together the formal and informal interviews produced a great deal of rich data that was collected, coded, analyzed, and interpreted. An Interview Protocol Sheet is included in Appendix E.

Field Observations

Field observations were a way to go inside the setting; to help the researcher discover complexity in a social setting by being there (Rossman & Rallis, 1998). In the early part of the study observations were used to enter the setting without very broad categories. The researcher sought to discover the recurring patterns of events and relationships. These first observation visits informed the categories and observational checklist items that were used in subsequent observations. This process allowed observation experiences to be more focused and context sensitive as the study progressed.

The researcher turned what they saw and heard into data. Field notes were used to accomplish the task, they were the written record of the researcher's perception in the field. The field notes taken during early

observations informed subsequent explorations in the process described above. The researcher used a double entry style to record observation notes. Notes were gathered in two major components: the descriptive data and the observer's comments on those data (Rossman & Rallis, 1998). The descriptive data were data about the research while the observer's comments were data about the process and the researcher.

The descriptive data detailed as much as possible about the physical environment and the activities and interactions among the people in that setting. Using videotape during some field observations helped to collect a rich amount of descriptive data. Artifacts collected throughout the study added additional detail and depth to the descriptive data.

The observer's comments were also recorded the field observations. The comments were expanded when the researcher reflected on the experience after the classroom episode had ended. These data included emotional reactions to the events observed; analytical insights; questions about meaning; and the researcher's thoughts about modifications in the research design. Field notes were also used to add to the transcripts of interviews conducted for the study. Adding descriptive data and observer's comments to interview data is similar to expanding those data after an observation.

Field observation notes were collected using the observation form illustrated in Appendix F. The form included alignment to the indicators from

the target levels of the Levels of Technology Integration (LoTi) framework. The intentional alignment with the LoTi framework helped to maintain a focus during field observations that resulted in a unswerving dedication to integration in the context of core curriculum and higher level thinking by students. The first column of the form "LoTi Level / Criteria" listed both the numbers and text descriptors for the eight discrete levels of integration established by the LoTi framework. The observer was able to use this column as a continuum to indicate the level of integration seen in the setting. Any evidence of participation at a level indicated the level had been achieved. The LoTi Framework was not concerned about the percentage of time spent at a certain level or other weighting of the criteria. For example, if evidence of authentic problems was observed the LoTi level is set at 4b. Key indicators to help determine level included the context of the technology use, and the evidence of higher order thinking skills being used during the learning.

The second column "Observation" was filled in by the observer in real-time. Notes were collected while observing and talking with participants. The observer was taking an active, social role in the setting and he contributed to the overall context of the learning taking place. Any immediate observations or insights were jotted down in column two. Special attention was paid to the interaction of participants and the way technology was used to assist in the task, project, or problem being solved. Short notes were made about the social

context and higher order thinking skills that led to the continuum choice made in column one.

The third column of the form "Reflection / Evidence" was designed to be an opportunity for reflection at a later date; although evidence to support comments made in the "Observation" column could have been added in real-time. This followed a double-entry journal format often used in language arts curricula. It was an opportunity for the observer to create meaning from what he had experienced in the social context. The Observation Log was intentionally divided into rows to visually represent the alignment of criteria, observation, and evidence. The log was printed and used on a clipboard, but it was primarily used in digital form to assist with the analysis of data. The observer either used a handheld computer, laptop computer, or desktop computer to view and use the Observation Log. The use of the application Documents To Go allowed the Microsoft Office document to be used, and synchronized, with either desktop, laptop, and/or handheld computer. The completed Observation Logs were centrally stored, viewed, and analyzed while remaining in the digital domain. Two-year old data from a district-wide LoTi survey conducted were available for comparison (Appendix G).

Videotaping

Videotaping was used primarily as a way for the researcher to "return to the scene" and reflect on the field observation data. The taping also supplied additional footage that teachers might use while creating and editing

their Digital Story Project. These two purposes are similar when you consider the use of footage by participant teachers as a way to revisit their own classroom experience. It provided them with a perspective they were unaware of, or physically unable to view, during the time of the instructional episode.

Adding the use of videotape to some field observations allowed the researcher to watch a classroom episode and expand the descriptive data and observer's comments data in the field notes for that event. The researcher often spoke comments quietly while taping. This practice provided a process similar to the double-entry journal. Taping and commenting allowed video data to enrich the collection of descriptive data. Goldman-Segall (1998) preferred video data for many reasons, including the density of data collected by this particular medium. Sights, sounds, and a sense of time and ambience were all captured simultaneously when motion video was employed.

Since the video footage captured during observations was not limited to viewing in real-time, the use of videotaping created a valuable data source for the researcher's reflection, comments, and questions. The video data were also useful when presenting questions and reflections with the study groups. By removing the limitation of real-time viewing the video data become a powerful tool for ongoing learning, discussion, and collaboration among participants to improve the practice of technology integration in their own classrooms.

Teacher participants recognized the unique value of certain videotape portions to expand or reinforce the themes of their own stories. Because of the value to both researcher and participant this study investigated appropriate ways for teacher participants to access video data recorded in participating classrooms. Possible solutions to providing appropriate access included distribution of video data via email, on CD-ROM, DVD, and by web-based access through www.crteacher.com. All reasonable efforts were made to give participants ready access to their video data.

Artifacts

Often the relevant data were obvious, but very important data were sometimes unobtrusive (Rossman & Rallis, 1998). Artifacts were collected throughout the study to intentionally gather data that were not always obvious. Student work was the primary artifact collected but other artifacts became apparent as the study progressed. Items emerged during the study that represented key aspects of the integration process, salient pieces of learning, or powerful representations of a shift in attitudes or beliefs.

Although the term documents is routinely used as an overarching category of text items there was a difference in interpretation necessary between records and documents. Hodder (1994) made a distinction between documents and records when he noted that documents are prepared for personal rather than official reasons. The diaries, memos, assignments, letters, notes, journals, reflections, field notes, and other documents that the

researcher collected are clearly in the document category. These artifacts were closer to speech, and require a more contextualized interpretation. Meaning does not reside in text, but in the writing and reading of it. As the text is reread in different contexts it is given new meanings.

These written artifacts gave insights into the ways in which teachers and students perceived and fashioned their meaning making. They represented a residual piece of their learning. Documents provided an important and different insight from that provided by any type of questionnaire or survey instrument. The material traces of behavior were a much more accurate picture than answers given during interviews. What participants said was often very different than what participants did. The study of the material culture became very important for the qualitative researcher who wished to explore multiple and conflicting voices, differing and interacting interpretations (Hodder, 1994). Analysis of the material traces is not unimportant. The mundane and the daily routine was of great importance for the expression of alternative perspectives. It was the creation and exchange of the material artifacts themselves that constructed social relationships. Hodder (1994) argued that an adequate study of social interaction depended on the incorporation of mute material evidence.

Collected artifacts always had the potential to be patterned in different ways than the observed culture. The artifacts collected provide an "other" perspective from which the researcher compared his own experience of the

world and evaluated or enlarged his understanding (Hodder, 1994). This was another example of the embedded use of reflection in the research design. The artifact data were simultaneously evaluated in three areas: the identification of the contexts; the recognition of similarities and differences; the relevance to general or historical theories to the data at hand.

In identifying the contexts the primary question became, were the different examples comparable, were the apparent similarities real? Recognizing similarities and differences was mutually dependent with the identification of the context. The researcher argued for a context by showing that things were done similarly, that people responded similarly in similar situations. The relevance to theory is connected to detailed, thick description of associations and contexts that allowed the material practices to be set within specific situations to be understood and interpreted (Hodder, 1994).

Specific artifacts desired for collection in this study included: student work, learning resources created by the teacher, and additional items used in the creation of the Digital Story Project. The culminating Digital Story created by the teacher participant was an artifact that was intended to be collected to help in answering the research questions. Other artifacts emerged during the course of the study and created added meaning when they are included in the interpretation of data. The collection and analysis of artifacts was an intentional portion of the study design to gain rich description and additional perspectives of the participants' experiences.

The Digital Story Project

The Digital Story Project was a summative assessment that allowed the participant to demonstrate their understanding of successful practice for improved technology learning. The Digital Story Project was a way to chronicle the growth and reflection that led to improved practice. The LoTi framework provided a strong guide for evaluating the quality of the technology learning experienced by the teachers, students and researcher.

The Digital Story Project coincided with the observations made by Goldman-Segall (1998) who observed that each individual had many ways of seeing events or reading texts. We cannot be limited to one point of view, or even one point of viewing. The Digital Story Project took advantage of the emerging tools that enabled us to understand events from many perspectives, to see many sides to a story. These emerging tools extended our boundaries to enable us to see from the perspective of others; we saw how others both see what we see and what we do not see (Goldman-Segall, 1998). In this context the computer became a cultural partner by expanding our social context to include perspectives we would not otherwise see. The Digital Story Project represented knowledge constructions created by the interaction between what is already known and what is yet to be known again in a new form (Goldman-Segall, 1998). We stretched our own knowledge by finding out what others saw and knew.

Timeline

The study took place over a six week period. Each of the four teachers was interviewed near the beginning of the study to discuss their learning goals and beliefs about technology integration. This moderately-structured interview included some open ended questions, but it also included questions about the participants' LoTi Survey results. Each of the four teacher participants was interviewed near the end of the six week study using a dialogic interview. Questions in the final interview were aligned with certain aspects of the initial interview, but the quantitative nature of the study necessitated the creation of questions that had to be determined during the research study. The time between these two formal points of data collection included many informal conversations and opportunities to share and reflect during journal writing or study group sessions. The six weeks of the study gave the researcher the opportunity to do field observations in the participants' classroom.

The researcher conducted one field observation in a two-week period for each teacher. That resulted in three observations for each participants, and twelve field observations in total. Field notes were collected during each of the twelve observations. One observation, or more, from each teacher was also recorded using a video camera for continued data analysis. The four sessions captured on video tape allowed in-depth analysis by the researcher, and was made available to the participant for additional raw footage they could use during the creation of their digital story. To help manage the large amount of

digital video data the researcher created backup copies of the field observations using inexpensive DVD-R media. This disc allowed the participant to review and reflect on the instructional episode that was recorded. Backup copies of the DVD-R discs provided a convenient way for the researcher to review field observations from almost any computer or television. When the need to access raw footage in the original Mini-DV format was encountered the researcher was able to return to the original data using the archived Mini-DV tapes or footage already housed on the local hard drive.

The decision to limit taping at the four field observation sites was an intentional choice to balance ample depth of data collection while maintaining a data analysis design that is doable by a single researcher. Videotaped data is only one of the multiple data collection strategies that was employed in this study. Additional artifacts, informal interviews, and journal entries were collected throughout the study. A weekly meeting with the four participants was one opportunity for reflection and data collection. The study group was a place where participants began to create meaning from their individual classroom experiences. As a study group facilitator the researcher had direct access to rich data points including: participant dialogue, teacher-created products, student work, lesson plans, and other artifacts.

Summary

An assortment of data collection strategies assured that data were gathered from multiple perspectives and many areas in the natural setting. The following table showed the alignment of research questions and various methods of data collection that have been described.

Table 3 – Research questions and methods of data collection

Research Questions	Method of Data Collection
Main – What kinds of ongoing learning appear to facilitate the integration of technology with core curriculum?	Journal & Listserv • Interviews • Field Observations • Artifacts • Digital Story Project • Study Groups
Sub Question 2 – How can the Levels of Technology Integration (LoTi) framework assist in the process of ongoing learning and goal setting?	LoTi Questionnairre • Technology Lesson Plans • Journals & Listserv • Interviews • Artifacts • Study Groups
Sub Question 3 – How does the construction of a digital story affect the meaningful integration of technology with student learning?	Journal & Listserv • Interviews • Field Observations • Artifacts • Study Groups
Sub Question 4 – What kinds of social contexts assist in the construction of richer learning environments for students?	Journal & Listserv • Interviews • Field Observations • Artifacts • Study Groups
Sub Question 5 – How can we explain the limited integration of technology with core curriculum despite generous access to technology resources?	LoTi Questionnaire • Journal & Listserv • Interviews • Field Observations • Artifacts • Digital Story Project • Study Groups

Data Analysis Strategy

Data analysis was an ongoing process that involved continual reflection about the data, asking analytical questions, and writing memos and reflections. It was not sharply divided from other activities in the study, such as collecting data, or revising research questions (Creswell, 2003: Rossman & Rallis, 1998). Asking general questions and analyzing participant responses was a significant part of dealing with the open-ended data that were being collected. The researcher anticipated the continual examination of data to guide the creation of new questions, inform the areas of exploration, and contribute to a deeper understanding of the events and experiences being observed and shared with participants.

The overview of data analysis in this study was consistent with processes recognized for qualitative studies. Creswell (2003) outlined the process in the following six steps: organize and prepare the data; get a general sense of the data; coding; description; representation; and interpretation. The ongoing process of data analysis in this research study followed the same general format.

Organizing And Preparing Data

During this step the researcher transcribed interviews, optically scanned material, word processed field notes, and arranged data in types depending on the source of information. Transcripts were often returned to participants to confirm accuracy and generate any further data from

participants' comments and reflections. During this stage the researcher explored computer applications to assist in the organization of data to determine if such applications were beneficial to the study.

Data collected electronically was consolidated to help with understanding. MS Excel, and MS Word were used to summarize the web-based survey data and other data collected during the study. Results of these data were organized in numeric form.

General Sense

Data were read over several times as the researcher sought to create meaning from the data that had been gathered. The researcher added notes to physical documents or added electronic comments to digital data. Editing features in word processing software and "notes" fields in digital editing software allowed the researcher to add comments and reflections in the digital domain. This allowed the researcher to sort and code comments and reflections in a manner similar to the participants' data.

Qualitative data was read and viewed repeatedly to identify trends and patterns that connected with the professional development methods being implemented. Results of these data were described in narrative form. Digital tools were available to make meaning from participant data and the researcher's reflections and comments. The researcher looked for general

ideas the participants were saying, the tone of those ideas, and the depth and credibility of the information (Creswell, 2003).

Coding Process

A detailed analysis began with the coding of data. The data was examined and organized in "chunks". Text data, still images, motion images, artifacts, and any other data were placed into categories that were labeled with a term. The term used was often an *in vivo* term based on the actual language of the participant (Rossman & Rallis, 1998). Some software applications explored during the organizing of data proved beneficial during the process of coding.

The researcher intentionally chunked data in several ways to assist with the process of creating meaning. Sorting data by the "chunk label" allowed the data to be seen from several perspectives during the coding process. It was expected that new understandings would emerge as data was seen in complex relationship. Peer reviewers helped validate the connections being made by the researcher.

Description

During the description step the researcher offered a detailed accounting of the people, places, events, or artifacts in the natural setting. Codes were also generated for this description. The codes were used to generate a small number of themes, or categories that appear as major findings of the study.

These categories displayed multiple perspectives, and were supported by multiple examples of evidence from the study.

These themes were used to describe the findings, but also to add layers of additional analysis. Themes were compared to each case, and across cases in the study. The goal of this study was be to go beyond identification of themes to the connection of themes in complex systems throughout the study.

Representation

The description of the findings was reported in a qualitative narrative. The narrative contained a discussion of interconnected themes that included, chronology of events, specific illustrations, multiple perspectives from participants (including data contrary to themes), and quotations. Additional media (e.g. tables, diagrams, still images, motion video) was used to convey the findings and advance the discussion of the study. Tables were also used to convey descriptive information about individuals or events in the study.

Interpretation

Interpretation represented the final step in the data analysis process. During this step the researcher made meaning of the data. Creswell (2003) pointed out that the lessons learned during the study can be reported in a number of legitimate ways – the researcher's personal interpretation, based on the individual understanding the inquirer brings to the study in their culture, history, and experiences; meaning derived from the comparison of the

findings with information gained from the literature, or theories; it can also suggest new questions that need to be asked – unforeseen questions raised by the analysis of data.

The Narrative

The description of data and discussion of findings in the study followed the conventions outlined by Creswell (2003) they included: varying the use of long, short, and text-embedded quotations; scripting the conversation and stating the conversation in different languages to reflect cultural sensitivity; presenting text information in tabular form (e.g. matrices); using the wording from participants; intertwining quotations with (the researcher's) interpretations; using indents or other special formatting of the manuscript to call attention to quotations from participants; using the first person "I" or collective "we" in the narrative form; using metaphors; using the narrative approach of description that is typically used in a qualitative case study approach.

Verification

Validation of findings occurred throughout the steps of the research process, yet the importance of accurate data merited an explanation of additional steps that were embedded in the research design of this study. Unlike quantitative research validity is not the companion of reliability or generalizability. In this study reliability was used, in a limited way, to check

for consistency of theme development among the researcher and third party observers. In this study it was possible to generalize some aspects of the data across the cases being examined. Validity, on the other hand, is seen as a strength of qualitative research (Creswell, 2003). It seeks to determine if the findings are accurate from the perspective of the researcher, the participant, or the readers of the account.

In addition to the appropriate application of reliability and generalizability during the stages of data analysis additional strategies were used to ensure the internal validity of the study. These specific strategies incorporated in the study included:

Triangulation of data – by analyzing many different data sources this study examined evidence from multiple sources to build clear themes. The representation of multiple perspectives supplied a richness to the data collection process while adding reliability to the themes that were identified from the evidence collected from the sources.

Member checking – to help determine the accuracy of the qualitative findings the themes, descriptions, or final reports were returned to the study participants for their comments. The basic question asked by the researcher was, do you feel these themes, descriptions, or reports are accurate?

Peer debriefing – the researcher located a person to review and ask questions about the case study as it unfolded. This was to ensure that the account of the study resonated with a person other than the primary

researcher (Creswell, 2003). This process increased the accuracy of the account presented by the researcher.

Third party observers – two educators were trained in the LoTi framework and asked to assist with the field observation data. They were free to conduct independent observations and gather data that was compared to the researcher's data collection. By reviewing observation data with the researcher they engaged in peer debriefing with the researcher in this specific area of data collection and analysis.

Clarification of researcher bias – self reflection by the researcher fostered the creation of an open and honest narrative. The researcher intentionally reflected on the lens being used to observe, infer, and interpret data. Attention to beliefs about learning, technology integration, and systems was examined; especially as they relatde to past or shared experiences in the natural setting the research was being conducted in.

Presentation of discrepant information – negative information (information that runs counter to the themes) was included in the study. Discussing this discrepant, contrary information added credibility to the account for a reader.

Accuracy of data was enhanced further by the use of thick description to convey the findings. This helped the reader get a better picture of the setting and gave the discussion an element of a shared experience. As mentioned earlier, it was anticipated that this detailed description would also

include discussion of any data that run counter to the themes. Research undertaken in the natural setting was composed of different perspectives that did not always join together neatly.

Summary

Overall reliability and generalizability played a relatively minor role in qualitative study, but validity was seen as a strength. Validity in the qualitative study was used to suggest determining whether the findings were accurate from the standpoint of the researcher, the participant, or the readers of an account (Creswell, 2003). The study included intentional strategies to continually check the accuracy of the findings during the research.

To help determine the accuracy of qualitative findings the final report or specific descriptions or themes were taken back to participants to question whether the participants felt they were accurate. Member checking acknowledged that the study findings could not be separated from the context in which the study took place. Although the researcher played a specific role in the research process each member brought a perspective that was needed to complete a deep, rich description of the study and its context. The case study model being used allowed the researcher to do member checking with each participant before the findings were completed.

Member checking assisted the researcher with attaining accuracy in the qualitative findings of the study. The process also lent credibility to the

findings. When the final report or specific descriptions or themes were taken back to participants to determine whether these participants felt they are accurate it was adding a perspective to the researcher as he created the narrative. A similar strategy involved using a peer debriefer. This was a person outside of the study who reviewed findings and asked the researcher questions about the qualitative study. Both member checking and peer debriefing were used to enhance the accuracy of the study and communicate a report that would resonate with people other than the researcher.

Using rich, thick description to convey the findings of the study helped transport readers to the setting and context where the research took place. This gave the discussion a certain element of shared experiences. This technique was related to, but different than, the purely ethnographic notion of thick description focused on researching the culture of a particular setting such as the work of Goldman-Segall (1998). The data collected through interviews, field observations, and videotaping was especially useful with this validity strategy. The narrative and digital story examples collected from participants also assisted the creation of a thick description.

Additionally the researcher clarified the bias that he brought to the study. This type of reflection not only clarified understanding, but lent an honesty and integrity to the narrative that resonated well with readers. Presenting negative or discrepant information that was collected during the study was a related strategy that was also incorporated in the design for the

purpose of increased validity. Reporting information that ran counter to the emerging themes mirrored the multiple perspectives encountered in real life that do not always neatly arrange themselves in unified way. Openly addressing these contrary elements added a great deal of credibility to the account for a reader.

Finally the researcher planned to triangulate various data sources by examining the evidence gathered and using this evidence to create a coherent justification for the themes that emerged. Discovering evidence from multiple sources that aligned with the emerging themes was an effective strategy to negate a researcher's bias and enhance the exploration of multiple perspectives. Using this evidence to construct a logical argument for the interpretation of data gave credibility for the readers of the account. The multiple sources of data collection employed by this study allowed for the use of triangulation as a powerful method to ensure credibility and believability of the research findings.

As is typical in qualitative study the researcher was directly and intensely involved with the participants during the inquiry. Qualitative research was interpretive research. Many strategic, personal, and ethical issues were introduced into the research process. To attain valid findings in the midst of such complex issues was not an impossibility. It is arguably the only authentic context in which complex issues of learning, relationship, and situation can be studied. The steps for checking the validity of findings

mentioned in this chapter all related to the intentionality of the research design and the researcher's desire to explicitly identify bias, values, and personal issues related to the research question, setting, participants, and process that were a part of this study. The researcher's participation in in-depth data collection, ongoing analysis, and interaction with the research site were pivotal in the ultimate goal of the research study – finding answers to the research question. A more removed, hands-off approach in the research process would have eliminated some of the "stickiest" situations mentioned above, but could not possibly have supplied the experiences necessary for the interpretation of findings and meaning making required to explore, discover, and understand the complex relationships and interactions that contributed to rich learning. Qualitative research was the best fit for the questions being asked and the context being studied. Adhering to specific strategies insured that findings were both doable and believable.

Chapter Four: Results

The study described in this chapter shows how students and teachers used technology tools to enhance learning. The chapter is organized by the research questions that frame this study: 1) What kinds of ongoing learning appear to facilitate the integration of Technology with core curriculum? a) How can the Levels of Technology Integration (LoTi) framework assist in the process of ongoing learning and goal setting? b) How does the construction of a digital story affect the meaningful integration of technology with student learning? c) What kinds of social contexts assist in the construction of richer learning environments for students? d) How can we explain the limited integration of technology with core curriculum despite generous access to technology resources?

Each of the four classrooms has unique elements concerning curriculum, teaching style, physical layout, technology available for integration, and grade level of students. Major themes were drawn across these settings. Themes are discussed as they relate to the research questions at each unique site. Some of the themes identified span all, or several of, the research questions and may be referenced in more than one section of the findings.

Table four shows the alignment of each research question with the data collection methods, timeline, and particular analysis used to inform the findings being reported.

Table 4 – Data collection and analysis timeline

Question	Methods	Timeline
1. What kinds of ongoing learning appear to facilitate the integration of Technology with core curriculum?	Interview Field Observation Videotaping LoTi Questionnaire Artifacts	Weeks 1–6
1a. How can the Levels of Technology Integration (LoTi) framework assist in the process of ongoing learning and goal setting?	LoTi Questionnaire Interview Artifacts	Weeks 1–6
1b. How does the construction of a digital story affect the meaningful integration of technology with student learning?	Interview Field Observation Videotaping Artifacts	Weeks 3–6
1c. What kinds of social contexts assist in the construction of richer learning environments for students?	Interview Field Observation Videotaping Artifacts	Weeks 1–6
1d. How can we explain the limited integration of technology with core curriculum despite generous access to technology resources?	Interview Field Observation Videotaping LoTi Questionnaire Artifacts	Weeks 3–6

A case study design was used to gain understanding of the interactions, practices, and contexts that are hindering or fostering the integration of technology with learning experiences. Field observations, formal and informal interviews, videotaping, artifacts, student work, and teacher interaction on the web were used as data during this study (see Table 4). The researcher observed study participants in their classroom setting and videotaped, or took field notes, for additional data gathering. The researcher videotaped interviews with participants and collected artifacts, including student work, throughout the study. Additional data were collected from teacher participants at a web-based resource designed to assist with the participants' individual reflection on learning and build their shared community of practice. Artifacts and documents were collected and assessed on whether or not they met the curricular learning goals and technology standards from the NETSS and LoTi frameworks.

Research Setting

The study was conducted in a suburban school district in southwestern Pennsylvania at four separate locations. Two elementary schools, Washington Elementary and Twin Valley Elementary; and two secondary schools, Dawson Junior High School, and Taylor Senior High School. The study took place in a third grade classroom, a fifth grade classroom, an eighth grade math

classroom, and an eleventh grade social studies classroom. The study was conducted in a six week period during April and May of 2006.

The names of the schools have been changed and the names of all individuals who participated in this study have been changed. Pseudonyms were used to ensure their anonymity.

The area surrounding Washington Elementary School is filled almost exclusively with single homes. Many homes have large, manicured lawns and three-car garages. Amenities like elaborate decks or patios and in-ground pools are common. Moving a little further away from the school's immediate surroundings reveals farmhouses and homes that are older and less spacious. There are no sidewalks to allow students walking access to school, so all children who attend Washington Elementary School ride the bus when they arrive and depart. There are 452 students in grades kindergarten through fifth grade that attend this school. Washington Elementary School is the newest school of districts' nine buildings. Construction was completed in 2002. Visitors exit Mill Pond Road and enter the long driveway that leads to twin parking lots in front of the main entrance. Traffic is carefully routed so the flow of bus traffic does not interrupt the drop-off and arrival of parents and students commuting in their family cars. The driveway, parking lots, and grassy areas in front of the school are all professionally landscaped. The general classroom climate I observed here appears to mirror the detached,

professional appearance that marks the exterior of the school building and grounds.

The large inviting playground area behind Washington Elementary School is often filled with children and parents after the school day ends. The gymnasium is used for community groups for after school programs, adult exercise classes, and children's basketball, cheerleading, and soccer programs.

Each time the researcher visited he had to walk through the first set of double doors and ring a buzzer to gain access to the main office. After visual confirmation from one of the two secretaries the researcher would enter the main office and sign in. These physical barriers isolated the guest in way that the construction of the pods isolated teachers. These design aspects may contribute to the low level of interaction among professional staff concerning the use of computers and other instructional technologies. The office staff was always very welcoming and engaged the researcher in a few moments of light conversation. All visitors were issued a special security pass if they did not have a district name badge. After exiting the office the researcher crossed a large foyer area and proceeded down a stairway to the lower level. Three clusters of classrooms, or pods, were spread across the lower level. Each pod had a name that corresponded to a local municipality. Grade level classrooms were clustered in the pods, and large bulletin boards displayed student work from one end of the one-hundred-fifty foot hallway to the other. The large distances between teachers' rooms reinforced the isolation of teachers from

each other. Physical layout makes it difficult for teachers to see or visit each other's rooms. The architecture seems to influence the culture of practice represented in the professional staff. The teachers' lack of discourse about integration might be related to the barriers present in the physical structures of the school.

When the researcher left the hallway and entered the third grade pod he proceeded to the back, left corner and entered Mrs. Melinda Foster's classroom. Mrs. Foster had a very colorful and inviting room that was decorated with academic posters, student work, posters listing character traits, and an occasional lamp, chair, or fixture that reminded me of a cozy living room. Desks were not arranged in traditional rows, instead they were arranged in two, concentric, horseshoe-shaped groupings. One computer was sitting directly behind a work table on a counter that ran across the back of the room. The isolated placement of the computer seemed to indicate a view of technology that treated integration as something to be added-on to instruction as opposed to an aspect of learning and knowing that is integral to the core learning.

Directly in front of the doorway was a set of large windows that looked out into the playground area. Natural light flooded the room. A large throw rug and wicker rocking chair defined an area to the right of the windows that was regularly used for reading, literacy, and community building activities. A table with four chairs was on the left side of the room and Mrs. Foster used

that table for conferencing, flexible grouping activities and collaborative group work. The room layout appeared to be designed in a manner that allowed non-technical communication to flow easily from instruction, but limited the ease of computer use. Part of this limitation can be attributed to the lack of electrical outlets near the conferencing tables.

Mrs. Foster is a 50 year old teacher who has been teaching for eleven years. All eleven years have been in the same district. She has taught for several years in a multi-age classroom, but has been teaching in a third-grade classroom for the past four years. Melinda was a master teacher who was fairly comfortable with the use of technology. She was a somewhat reluctant risk-taker, often called on by her principal or peers to pilot a particular instructional or technology program. She was participating in program to attain National Board for Professional Teaching Standards (NBPTS) certification that the district was offering. Mrs. Foster's initial Levels of Technology Implementation (LoTi) Online Questionnaire survey resulted in an overall LoTi score of three, or the Infusion Level. Data collected during this study align with the criteria for the Infusion Level.

Just a few miles from Washington Elementary School was one of the older elementary school buildings in the district. Twin Valley Elementary School was built more than 60 years before Washington Elementary was opened. The homes surrounding Twin Valley Elementary School were also older structures. Many of the original farmhouses from the area stood next to

the newer homes that had been built after the farm lands had been sold and subdivided. Some of these newer homes were among the most expensive properties in the entire school district. This diversity of housing was also represented in the socio-economic strata of the student body at Twin Valley Elementary School. The inclusion of upper-middle class and upper-class parents may influence the higher expectations about technology access and use that are part of the Washington Elementary expectation. This school, for example, has included a technology fair theme in their open house activities many times. Only 372 students attended this elementary school and, like Washington Elementary School, the large majority of students were bused to the school each day.

Twin Valley Elementary School was built less than a quarter mile from one of the main, two-lane roads that served as a primary thoroughfare in the township. You could hear the heavy traffic when you stood at the main entrance of the school, but it was not easily heard after entering the building. The short drive from the main road on Hill Lane felt like exiting an off-ramp. The school was on the right side of Hill Lane, and a gentle right turn lead you directly to the small, main parking lot in front of the building. After walking up the steps to the front doors the researcher could easily see the main office before entering the building. This made for easy visual confirmation of all visitors arriving at the school.

The office staff was always friendly and greeted the researcher with a welcome "hello" each time he arrived at the school. The smaller hallways, older wooden trim and lower ceiling heights throughout the building gave the impression of entering more of a home atmosphere. Only the long hallway stretching to the left and right near the main office doors reminded the researcher that he was in an institutional setting. Traveling the long hallway to the left of the office eventually led to a circle of classrooms that bordered Twin Valley Elementary School's library. Almost exactly half way around the circle was the doorway that led to Mr. Evan Stonehill's room.

Mr. Stonehill's room was filled with student work. The bulletin board at the doorway was covered with a creative writing assignment that had been completed a few weeks before I arrived for the first field observation. The close proximity of classrooms, and common-access path to reach them, may contribute to Mr. Stonehill's ease of collaboration with grade-level peers. The physical layout of the classrooms seems to allow routine exposure to the student work from other rooms. This climate of openness may account for the ease Mr. Stonehill displays concerning collaboration and shared practice. These characteristics may have influenced Mr. Stonehill's higher performance on the Levels of Technology Integration (LoTi) indicated by his results after completing the online questionnaire.

Mr. Stonehill is a 43 year old, veteran teacher who has been teaching for 20 years. All 20 years have been with the same district, and almost all of those

years were spent teaching fifth grade. Evan was very familiar with the use of technology and had been a leading pioneer in many of Twin Valleys' efforts to connect technology and learning. Mr. Stonehill's initial Levels of Technology Implementation (LoTi) Online Questionnaire survey resulted in an overall LoTi score of two, or the Exploration Level. Data collected in Mr. Stonehill's classroom aligned more closely with higher levels of the LoTi framework. Data were indicating a potential readiness to move to Level Three – Infusion.

The secondary schools in the research study were located on the other side of the districts geographic borders. Dawson Junior High School was a school built in the 1960s that initially was designed around the concept of open space instruction and was later renovated to include traditional classroom and hallway building design. The area surrounding Dawson Junior High School is filled with a mixture of single homes, attached row homes, and small apartment complexes. A large adult care facility is located within walking distance of the school. This facility is a combination of independent living houses and assisted care wings that rise several stories above the residential neighborhood. The district is largely a bedroom community and only rarely does an occasional, small pocket of industrial zoning break the residential setting. Modest homes with small lawns and detached garages line the sidewalks that lead to Dawson Junior High School. Amenities like elaborate decks, patios and in-ground pools are uncommon in this neighborhood. Moving a little further away from the school's immediate

surroundings places you in a grid of planned streets and municipal buildings that define one of the townships located in the district. There is a set of train tracks that runs close enough to the school to warrant added caution for those students walking home. There are numerous sidewalks to allow students walking access to school, so many children who attend Washington Elementary School walk or ride their bicycles when they arrive and depart. There are 1,095 students in grades eight and nine that attend this school. Dawson Junior High School is the newest secondary school in the district.

Visitors travel along Walnut Street, a state route, and enter the short driveway that leads to a large visitor parking lot in front of the main entrance. You need to drive past most of the building to reach the main entrance located on the east side of the building. A large parking lot is available, but you can also continue past the lot and exit the rear of the school grounds onto Sixth Street. This winding stretch of road along the school provides a place for dozens of buses to lineup in anticipation of dismissal each day. Local police monitor the traffic light at the main entrance daily to ensure a steady departure of the bus parade.

After parking and exiting the car the researcher walks up two sets of concrete steps and continues on a long stretch of sidewalk that passes between the original building and the modular classrooms erected to address the fast-growing student population Dawson Junior High School has experienced in

the last ten years. After buzzing in at the security door you only walk about fifteen feet before entering the main office.

Mrs. Norman's classroom is on the second floor and the researcher has several stairway options to reach the far corner of the building. After crossing a large, open cafeteria area the stairwells are straight ahead. Although the building lacks the dense display of student work that was evident on the elementary schools participating in the study there is evidence of student-created materials mixed in with the commercially made banners and signs. The most prominent student work is the rich collection of art projects that decorate the wall in a beautiful ceramic tile border, and the mural that is spread across most of the cafeteria ceiling. Pictures of students participating in student government, or receiving special recognition like "Student of the Month" are also visible in display cases near the main office. Displays of individual student work from academic areas are noticeably absent. The omission of these materials may be related to the isolated, non-public practices that characterize Mrs. Norman's classroom. Based on the public displays these non-public practices appear to be the status quo expectation at Dawson Junior High School.

After passing the rows and rows of lockers that lead to Mrs. Norman's room the researcher enters a room that mirrors the atmosphere seen in the building so far. The room is not stark by any means, but it is clearly an institutional setting. Three sides of the room are whitewashed concrete block

and the fourth side is lined with cabinets and a wall-to-wall countertop. One desktop computer sits on the counter behind the teacher's desk. One skinny floor-to-ceiling window breaks up the concrete block on the wall opposite of the counter and cabinets. Mrs. Norman has added numerous posters relating to math and problem solving on the large, white walls. All of the posters and displays are commercially created. There is no student-created work displayed on the classroom walls. Desks are lined up neatly in four rows and they face the whiteboard at the front of the room. The arrangement of desks does not seem to allow easy access for student collaboration.

Mrs. Louise Norman is a 55 year old veteran teacher who had been with the district for 20 years, and teaching in public schools for a total of 23 years. She had taught elementary music and served as a department coordinator in grades kindergarten through fifth before becoming a fifth grade teacher. She recently received her secondary math certification and moved to Dawson Junior High School where she was entering her third year of teaching math. Louise was a master teacher who was very comfortable with the use of technology. She desired to use technology with her students but often ran into problems of access to the technology tools. Mrs. Normans's initial Levels of Technology Implementation (LoTi) Online Questionnaire survey resulted in an overall LoTi score of one, or the Awareness Level. Data collected during this study dispute the criteria for the Infusion Level.

The artifacts created by Mrs. Norman's students reflect the relatively low levels of thinking that were inherent in the project assignments. The content-level intention of an assignment to familiarize students with web-based resources on the classroom site maintained by Mrs. Norman is a formative performance that appropriately expects only lower level thinking skills. The collaborative student performances related to a cross-curricular WebQuest activity however was a chance to explore, support, and expect much higher levels of thinking and problem solving. Student presentations were accurate, but demonstrated a cookie-cutter sameness that was an immediate indicator of an assignment that lacked a focus of building meaning and instead defaulted to reporting facts. This lower level of thinking skills, reflected in samples of student work, aligns with the LoTi data that were gathered in Mrs. Norman's pretest survey. Her goal reflection to "make my web site more explicit", "include technology in my planning, maybe even once a chapter", and "to use technology more – like graphing calculators and the projector" are concrete steps to move from Level 1, but lack an attention to the thinking skills needed to progress into the higher levels of meaningful integration.

The other secondary classroom participating in the study was located in Taylor Area Senior High School. As mentioned earlier in the chapter, Taylor Area Senior High School was near Dawson Junior High School. The high school, however, was on the farthest edge of the districts' northern boundary.

Taylor Area Senior High School was so close to the edge of the district that several of it's playing fields were actually located in a neighboring county. Taylor Area Senior High School was a very old school that had been renovated several times. As an indication of just how extensively this school has been transformed over the years it is helpful to know that the present auditorium stage was once the central gymnasium of the original building. Expansions, renovations and the construction of an adjacent indoor swimming pool have increased the capacity of the original building significantly.

The area surrounding Taylor Area High School is the heart of the downtown district. The property is bordered on two sides by neighborhood streets with small single homes on small building lots. The areas along Oak Drive and Second Street convey the stereotypical images of suburban living in the 1960's and 70's. The other two sides of the property, Commerce Lane and Main Street, border the football stadium and mark the beginning of the business area that spreads for several block before reaching a four lane state highway. This area is a mixture of family-owned or small business and the national chains familiar to most of us. The view from this edge of Taylor Area Senior High School includes: a Pizza Hut, a Mobil gas station, a CVS pharmacy, a large Blockbuster video store, both McDonalds and Burger restaurants, a Subway deli, and numerous other banks, eateries, and service stations. Several large business complexes are within a half-mile radius of the property.

There are numerous sidewalks to allow students easy walking access to school, and community members access to performances and sporting events. There are 1,617 students in grades ten through twelve that attend this school. Taylor Area Senior High School is the oldest secondary school in the district. Construction for a brand new high school began just a few weeks after the conclusion of this research study.

The visitor's parking lot is located across the street from the main entrance to the building. Large trees stand in front of the school and remind the researcher that this building has been around long enough to acquire some very mature landscaping. It stands in contrast to the newness of Washington Elementary School, the newest building in the district. After crossing the street the researcher walks across the short lawn in front of the school and enters the main lobby. Taylor Area Senior High School is the only building in this study that has its own security personnel, and these workers greet all visitors in a manner that presents a different tone than the office staff. After checking in with the security crew the researcher is able to walk straight ahead to a central stairway and go to the second floor. Mrs. Keaggy's room is on the third floor of the building and is located at the south edge of the original high school building. New additions that were economically placed beside several edges of the original high school structure make navigation in the resulting building a bit confusing and counterintuitive.

The walls of Taylor Area Senior High School contain almost no student work. The main lobby is adjacent to the guidance area and most of the free wall space is littered with posters from various colleges throughout the United States. Other commercial posters advertising rings, caps and gowns, and photographic packages line the sides of the stairway. A large plaque beside the main office contains photos and short biographies of Taylor Area Senior High School graduates who have gone on to make significant contributions in various fields including: business, law, education, medicine, music, literature, and others. Pictures of students participating in student government, or receiving special recognition like "Student of the Month" are also visible in a small display case built into the wall directly across from the main entrance doors.

After climbing the steps to the second floor the absence of student-created work is reversed. Four large, glass display cases house dozens of art projects from Taylor students. After exiting the lobby on the way to the third floor an occasional handmade poster is seen, usually advertising some aspect of student life, but no academic work produced by students is displayed in the hallways. The use of technology in the displayed work is noticeably absent. While art projects on the second floor may understandably emphasize a non-computer medium even the posters advertising student life activities were hand-drawn. The use of printed typefaces, clip art, or photos was rarely seen on the items hanging in the hallways. This lack of computer-assisted materials

may be related to the beliefs Mrs. Keaggy has for herself and her students concerning the use of educational technology.

When I reached the door to Mrs. Keaggy's room it reminded me of the classroom doors I had opened in my own elementary school decades ago. The wooden door was painted white and had four rectangular glass panes on the upper half of the door. The classroom behind the door was much smaller than the rooms of the other participating teachers. Four rows of desks lined the room, but instead of facing the front of the room the desks were arranged in separate, two-row groups that faced each other. There was an aisle created in the center of the classroom that allowed Mrs. Keaggy to walk from front to back without obstacles.

The stark room though not unfriendly, was clearly an institutional setting. One large window on the right side of the room provided plenty of natural light, and a nice view of the surrounding homes. The back of the room had bookshelves from side to side, and a small counter space that Mrs. Keaggy used to store all kinds of artifacts related to her social studies curriculum. There was one desktop computer in the front of the room resting on the small teacher desk set up in the right corner near the blackboard.

Mrs. Lauren Keaggy is a 44 year old teacher who has been teaching for only five years. All five years in the classroom have been in this same district. She had graduated from Taylor Area Senior High School and was a standout field hockey player. She coached several teams and taught social studies since

she joined the Taylor Area Senior High School faculty. Lauren was a highly competent teacher who was very comfortable with the use of technology. She had completed several graduate courses related to the use of educational technology at a nearby university. She desired to use technology with her students but often had trouble scheduling the limited tools that were shared among the faculty and students. Mrs. Keaggy's initial Levels of Technology Implementation (LoTi) Online Questionnaire survey resulted in an overall LoTi score of two, or the Exploration Level. Data collected during this study aligned with the criteria for the Exploration Level.

The overall impression the researcher observes is consistent with the occurrence of "pockets of creative practice" that include the use of technology to expand or enhance learning. But these areas are surrounded by classrooms and spaces more characteristic of entrenched institutional practices and appearances. The classrooms being visited by the researcher appear to be the exception, not the norm. The teacher participants do not appear to be in a physical location or community context that would allow rich interaction with peers. The physical classrooms appear to be isolated enough to prevent any visual "spillover" of integration practices from reaching the eyes of other professional staff members who frequent the spaces in close proximity. There appears to be a lack of innovation. Creativity might have been traded for conformity. Lack of creativity may even be a response to teachers who do not want too many front-runners generating additional expectations for the remaining professional staff.

Each teacher participant set a goal for their use of technology during the research study. The goal was created after participants completed the Levels of Technology Integration (LoTi) online questionnaire. Participants' goals are listed in the table below:

Table 5 – Teacher participants' integration goals

Mrs. Melinda Foster Washington Elementary School	"Use computer games and simulations to boost math problem solving skills" for students who were not meeting a proficient level of performance in the districts' Everyday Math curriculum benchmarks.
Mr. Evan Stonehill Twin Valley Elementary School	"Using technology as a constructivist tool. Using multimedia to expand and engage students in the Social Studies curriculum." He also wanted to explore the role of, "ubiquitous computing using Palm handhelds" in all aspects of the classroom learning community.
Mrs. Louise Norman Dawson Junior High School	"Make my web site more explicit", "include technology in my planning, maybe even once a chapter", and "to use technology more – like graphing calculators and the projector."
Mrs. Lauren Keaggy Taylor Area Senior High School	"Explore the Classroom Performance System (CPS) to create an interactive review" for a social studies unit summative assessment. She also desired to provide her students with, "email buddies for cultural awareness."

With these goals as a backdrop we can continue to examine the findings of the study. In the next section results and emergent themes will be organized by the relationship to the research questions from the study.

Research Question One

What kinds of ongoing learning appear to facilitate the integration of Technology with core curriculum?

Data collected during the study revealed several factors that influenced the use of technology for connection to existing curriculum and learning goals. Some of the areas identified resulted from a formal, intentional study of a specific aspect of integration, like the Levels of Technology Integration (LoTi) online questionnaire. Other factors of equal importance were discovered in the less structured, informal interactions and experiences participants' engaged in during the research study.

Key factors that surfaced during the study are, Culture and Context; Coaching; Self Evaluation of current integration practice; setting a Levels of Technology Integration (LoTi) Goal for lesson/unit planning; and examining current practice through Reflection. Each factor represents an important part of the process when connecting existing curriculum and technology.

Cultural and Context

Deeply entrenched practices and routines made any change in practice a difficult shift to undertake. A resistance to develop a community of practice using electronic resources was connected to the cultural context of the setting.

The absence of the digital story in its anticipated form was also influenced by omission of a community of practice among the research participants.

Longitudinal studies have shown a significant part of a strong technology integration experience has been linked to risk-taking and just-in-time support network available to professional staff. The tools provided for this study were unable to support, or persuade, participants to engage with them for the purpose of interaction and storytelling. The CRTeacher.com web site established for the study received only two posting that were not from the researcher – and each of those was created by the same teacher participant. Despite a high Personal Computer Use (PCU) score for each participant on the Levels of Technology Integration (LoTi) online questionnaire only one was willing to interact using the web 2.0 resources established for them. Evan Stonehill's insights regarding his non-use of the resource represented the thought of three participants. He summed it up by stating:

> I think that (web 2.0) breaks the mold for some people – it's beyond their thinking. The kids we are working with now are much more readily accepted (sic) of that. I view myself as fairly open to technology, yet I'm still somewhat resistant to go online and offer comments or start some kind of online dialog. Simply because I guess I've lacked some exposure to it. And I consider

> that it would take some time to be able to have that happen. One of my favorite sayings is that change is a process not an event. I think it would take quite a process to have that be able to happen, but it doesn't necessarily mean that it shouldn't occur.

Evan echoed a strong cultural belief held by other participants when he observed that his richest learning occurs in a face-to-face environment. He elaborated:

> I think sometimes it's ones' own personality as well, it's their conversation style, it's how they like to learn, it's how they like to share ideas. I've often considered, do I want to teach an online course? And in the end I'm not really sure that I want to because I enjoy meeting with people, talking with people, that's my own style of being able to share and also to learn as well. So those opportunities might work well for some, and not as much for other people.

These commonly-held beliefs about electronic collaboration were entangled with the comparisons of staff development versus graduate education. In many ways the expectations of the researcher for the study participants seemed to cross the line into the realm of graduate study. What

might be reasonably achieved during a for-credit course experience may not be a reasonable expectation for the ongoing learning of professional staff.

Competition for limited resources played out strongly in the integration process as well. This was a more relevant issue for the two secondary teachers. Mrs. Norman was very candid when she commented:

> So just the logistics of getting to the library, or getting the computers here – will they be available? Will the computers work? Most of the time they do, but the one or two times it doesn't then that kid has had a frustrating experience – as opposed to what I'm looking for which is an excited, um, progressive thing. You know?

Even the frustration with the sporadic reliability of the hardware and software available to her have not eliminated her enthusiasm. She continues, "However, the lessons I've done have been very successful. And I'm so happy with what I've seen that absolutely next year I will be incorporating, in all my classes, much more technology than I've done this year."

Louise continues to consider the culture and context of her school by challenging common practice with forward-thinking and innovative proposals. She challenges her peers and administrators by retelling an account: "I've even talked to Toby, can we not have another set of laptops? It would just be

so beneficial to all of us if we could do that. With the one set we have we're all fighting over that. With the one classroom we can schedule, we're kind of all fighting over that too. I had to make a deal with another teacher today just to get the room!"

Melinda noticed a change in the way she used technology at a building-level and wondered what had caused the shift,

> It was interesting to note that three years prior I was using technology better because we didn't have the technology special and I thought to myself, that was an eye-opener. And I'm glad I looked at it that way because you know, I was doing some higher level things. I was doing book reviews and having them on the intranet, inside the school system, and I asked people to respond to what the kids where doing so I really was doing a lot more interactive stuff so I thought to myself, gosh, why have I stopped doing that?

Without identifying a cultural component by name she had intuitively seen the shift that had occurred when teachers' classrooms, including her own, no longer functioned as the epicenter for technology integration work. Outsourcing the work of connecting curriculum and technology had created a

huge shift in the expectation, and routine instructional practice of her classroom.

The context includes many isolated attempts by teachers who try to integrate technology and learning. For example, Mrs. Keaggy was already in the midst of a small technology project when she agreed to participate in this research study. She had created an opportunity for some of her students to correspond by email with similar age students in foreign classrooms. The email "pen pal" exchange was not through a moderated web site, and students had reached an end in their assignment when I came to their classroom. I took the opportunity to ask questions of both the students and instructor concerning this use of email for cultural understanding.

Mrs. Keaggy indicated that the response from the pen pal students varied considerably. A few students were able to make a significant connection to a teen from a foreign country, but most students were unable to get much dialog going, even though the foreign students had volunteered to participate. This sentiment of frustration was echoed by several of the students I interviewed as well. For those students who were able to exchanges several email messages the experience was regarded as successful and worth the effort. The assignment was done completely outside of the classroom, and the exchanges were reported from student directly to teacher. No meaningful

classroom conversation was help regarding the email exchange idea. The design of this particular technology activity mirrors Mrs. Keaggy's LoTi result. Not only is it a relatively low level on the LoTi scale, but it shows a comfort for technology (email) without much of an intentional connection to existing curriculum. Students were given some guidance, but when the correspondence partner was not reliable the individual student suffered the loss of a cultural experience.

Her pen-pal email experience was planned and carried out in complete isolation from other teachers in her school or department. While individual attempts, and risk-taking behavior of pioneers will always have a place in the growth of an organization the lack of collaborative context, especially in the area of technology integration, weakens the overall occurrence of high-quality examples that fuel positive growth and change.

The primary technology project that Mrs. Keaggy identified and used for the research study was the use of the Classroom Performance System (CPS) for increased student engagement and better review opportunities prior to a summative unit assessment. This project represented another example of limited integration of higher order thinking skills. While the frequency of technology use by students was increased during the Class Room Performance System (CPS) implementation, the resulting experience was

characteristic of a limited integration experience when evaluated against the Levels of Technology Integration (LoTi) frameworks' criteria. It's a great example of how technology can "be everywhere" in an instructional setting, but simultaneously high-quality integration can be absent. The use of technology is high the integration of technology and curricular goals is low, or very low-level learning goals are driving the use of the technology resources.

Mrs. Keaggy was already familiar with the basic concept of the CPS system. When the loaner system arrived in her classroom we took some time to install applications and test the hardware and software. The installation was relatively simple. The biggest obstacle we faced was the lack of administrative privileges to install software on Dell desktop computer in her classroom. Once the technology support specialist in the high school was notified he was able to complete the software installation. Mrs. Keaggy spent the bulk of her time with the CPS to create content for her students.

Additionally, the CPS software was installed on a laptop computer so Mrs. Keaggy was able to take that portable computer home to create or modify the content she used with her classes. The CPS software allows users to create questions with multiple choice answers. Once correct answers have been identified the software can track student responses from wireless keypads that are assigned to individual students. Multiple series of assessment questions

can be combined in a Jeopardy-like environment for a more competitive experience. Mrs. Keaggy created several strands of assessments related to the chapter of her social studies textbook and used these questions to create an extensive review activity prior to her summative unit assessment. She indicated that final scores on the assessment were similar, perhaps slightly higher, to what she had anticipated based on previous experience.

Students were assigned a numbered CPS pad, and took very little time to learn the procedure for using the review activity. Mrs. Keaggy usually read the question that was projected on the large screen in the front of the classroom. The question had four possible responses (A, B, C, or D) and the students pressed the key of the response they felt was the best answer. Responses were collected electronically from the radio wave signal being emitted from the students' CPS pad. A receiver was connected to the desktop computer and it sat near the front of the classroom with very little distraction. Occasionally students would look for the remote receiver and point their pad directly at the device if the choice they were sending was not being received. The CPS screen provided feedback for the student user by changing their pad number to a different color after the response was received. A third color was employed when a user changed their mind and altered their initial response. The instructor provided a short period of time for students to make their

response in two way: 1) using verbal warnings like, “take 20 seconds to respond” or “I’m going to close the question, hurry with your response” or by using the built-in option of a countdown timer in the CPS software. Since Mrs. Keaggy was reading the question and responses she had to start the countdown manually. In practice the countdown and manual-prompting strategies were used almost equally. Whenever she forgot to initiate the countdown timer she used a verbal prompt instead. Students were usually the first to mention that the countdown was not initiated.

After ending the opportunity for students’ response Mrs. Keaggy clicked ahead to reveal the correct answer. The CPS software immediately showed a bar graph, or percentages of the students’ responses. It was rare to see the correct answer as the lowest response. This relatively low challenge atmosphere caused some students to begin inputting the incorrect answer simply to see the percentages of wrong answers reported by the software. The CPS system represented a ceratin novelty that engaged students initially, but after dozens of questions the routine became stale and many students checked-out of the activity. In fairness to Mrs. Keaggy, and the CPS system, she was at least able to hold students accountable for a response based on the visual data she was seeing as the keypad numbers changed colors. Mrs. Keaggy’s classes are conducted in a block schedule, so this particular class had

84 minutes in class. Most of this time was used for the CPS review activity with only a few transitions breaking up the large block of time.

When I conducted student interviews after the review session one student talking about their use of the Classroom Performance System (CPS) commented, "I would rather have it (the review activity) with pencil and paper because then you can go back and look at the questions. On the computer you can't go back". When students were asked if the CPS system helped them prepare for their unit assessment most were unsure. Several students liked the immediacy of the feedback. One commented about the automated feedback this way, "…the teacher doesn't have to grade your review, the answer is right there – the computer tells you if you got it right or not". He went on to say that the feedback, "it kind of gives you a little competitive edge because your friends are in there and you're trying to do better". When pressed to consider the impact of CPS when reviewing relatively uninteresting material one student summed up the responses of many when she replied, "it makes it more fun and everything is on the computer these days so we can really relate to it".

Another question the researcher asked each student was to consider how the use of the CPS system allowed something to take place that could not be done (easily) with pencil and paper, or whiteboard. Student generally

required some extra time to think about this question before responding. Their answers included, "the use of images. I like to see the pictures (maps) and it would be harder to do with pencil and paper", "I don't think they help or hurt anything because the kids in class say the answers out loud", "I'd rather have paper because I can take more time to answer and have more time to put a mental note in my brain", "after using it I have a better sense of the few questions I need to review to prepare for the test" , and "it doesn't really help me, especially on one computer in front of the whole class".

Coaching

While the mechanisms and procedures provided during the study for large group collaboration were met with limited use, the research study allowed each participant to have an increased opportunity to engage in one-on-one coaching with the researcher. This coaching was characterized by a high level of talk around the role of technology in learners' environments and more generally about the teachers' beliefs around student learners.

The discussion brought attention to the gap between participants' beliefs and practices concerning the use of technology and the everyday practices that relegated technology use to a relatively minor role in their instruction. The discussion of the gap was enriched by coaching opportunities.

Exposing this gap was primarily accomplished through two experiences: 1) these coaching conversations and 2) by requiring participants to complete the LoTi online questionnaire.

The coaching conversations between researcher and participants raised awareness of this broken connection between instructional belief and everyday practice. Participants generally initiated this high level of conversation, especially when considering the difference between their beliefs and their common practice. Comments from participants indicate the tension in their thinking:

> While I felt really comfortable with using handhelds, and using some technology, I found that I use them a lot to create products, I use them a lot to, um, maybe do things in a different way with regard to perhaps some demonstrations or perhaps having kids navigate to some web sites, but what I don't use technology to a great extent is through solving problems. And using the problems, whatever it might be, as part of that technology piece to enrich learning.

Coaching also helped move the realization of the belief versus practice gap into action in the classroom. There is risk involved with any new initiative

and the support for risk-taking may not be strongly in place with the building culture that's been established. Louise's comment points to the power of the coaching component to support initiative and risk when she remarked, "Thank you, I'm so glad you encouraged me to do this because I don't know that I would have tried it quite like this."

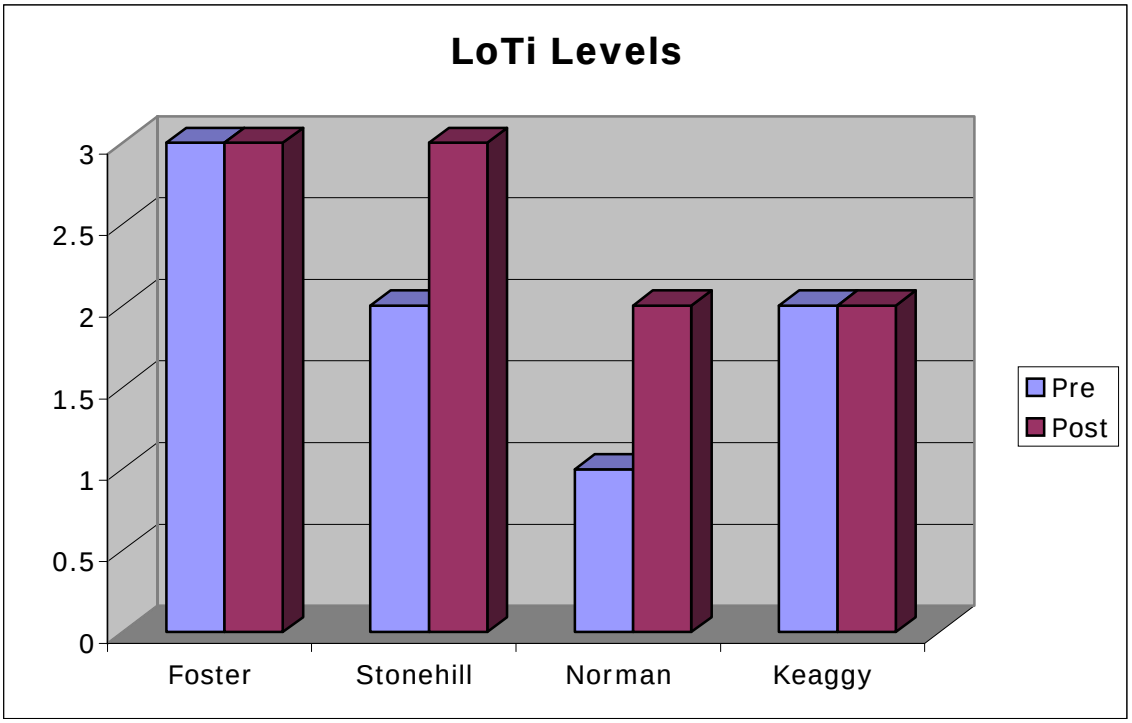
Self Evaluation

The act of slowing down to force each participant to examine their current practice may have been the most powerful aspect of this study. Each participant cited some aspect of the LoTi survey, or subsequent goal setting as a key aspect of the change that occurred in their integration understanding and practice. The LoTi online questionnaire was completed by each participant as their first step in the research study. During the final week of the study each posttest data were collected for comparison. Data for the LoTi portion of the study are shown in table six below.

Table 6 – LoTi online questionnaire data

LoTi Data From Online Questionnaire								
	Pretest Data				Posttest Data			
	LoTi Level	Level Name	PCU	CIP	LoTi Level	Level Name	PCU	CIP
Foster	3	Infusion	6	3	3	Infusion	6	3
Stonehill	2	Exploration	6	4	3	Infusion	6	4
Norman	1	Awareness	6	4	2	Exploration	6	4
Keaggy	2	Exploration	6	3	2	Exploration	6	3

Figure 1 - Pretest and posttest LoTi levels



The LoTi experienced was mentioned by participants in numerous interactions throughout the study. One participant identified it as the key aspect of the study for him. Taking the survey, and seeing the results in a visual form, jolted him to consider the current role of technology in his classroom. He immediately identified a particular aspect of the lower level of integration the survey results indicated, "I need to use technology to build those higher levels of Bloom's taxonomy – synthesis and evaluation – and have them use technology for problem solving purposes as opposed to just sharing what they know."

LoTi Goal For Planning

The Levels of Technology Integration (LoTi) survey results reported in three specific areas: 1) teacher participants' comfort level with technology 2) use and beliefs about student-centered learning 3) their integration efforts. Each participants' survey results represented a tension among these areas, and resulting data were very compelling. The combination of participants' initial shock and the subsequent opportunities to discuss the implications for instruction are at the heart of the professional dialog that frames this study. Mrs. Foster, Mr. Stonehill, and Mrs. Norman all implemented cooperative work that was focused on a performance task. Mrs. Keaggy used more

traditional assessment strategies that included the "piling on" of technology tools. This fundamental difference in the approach to student learning was observable in many of the classroom interactions and interviews conducted by the researcher.

When the use of technology was seen as a salient aspect of lesson or unit planning it made a difference in the level of integration. Prior to the study each of the teacher participants used technology more as an extension or remediation than as a core part of the learning environment being designed and planned.

Identifying short-term goals for the use of available technology helped focus the subsequent planning for the design of the learning environment where the students and teacher interacted. Each teacher participant in the study was asked to formulate one or two learning goals that linked their curriculum goals with their students' use of educational technology resources.

Mrs. Foster set an integration goal for her classroom to, "Use computer games and simulations to boost math problem solving skills" for students who were not meeting a proficient level of performance in the districts' Everyday Math curriculum benchmarks. In the course of the research study she also designed lessons that used computer tools for students' presentations in

science and whole-class enrichment in math, and attended a webinar with her class hosted by author and illustrator Peter Reynolds.

Mr. Stonehill established a goal of, "Using technology as a constructivist tool. Using multimedia to expand and engage students in the Social Studies curriculum." He also wanted to explore the role of, "ubiquitous computing using Palm handhelds" in all aspects of the classroom learning community.

Mrs. Norman developed a fairly targeted goal to, "Use a WebQuest model for a cross-curricular unit with math and social studies – using math skills in a problem solving context." She also desired to, "have a web page for supporting students."

Mrs. Keaggy wanted to explore the, "Classroom Performance System (CPS) to create an interactive review" for a social studies unit summative assessment. She also desired to provide her students with, "email buddies for cultural awareness."

These goals all contain language that relates to the design of learning environments and they are broad, overarching goals for students in general. None of the goals held specific learning targets related to the lesson or unit students were engaged in at the time of the goal creation. I do not consider this a weakness, merely an observation. It could be that the LoTi online

questionnaire helped each participant consider technology as a broader way of knowing and doing – rather than a drill-and-kill approach that so often accompanies integration efforts based on curriculum specific software or integrated learning systems.

The research study caused one participant to examine current practice and identify a gap in instructional design. The insight was voiced in this way, "I need to use technology to build those higher levels of Bloom's taxonomy – synthesis and evaluation – and have them use technology for problem solving purposes as opposed to just sharing what they know."

Reflection

Slowing down to examine current beliefs and instructional methods concerning the integration of technology helped participants make changes in their daily practice. Slowing down does not automatically lead to reflection, observations indicate that the use of the Levels of Technology Integration (LoTi) online questionnaire and the coaching discussions were two keys elements to help participants use their time for consideration of current instructional practices.

Mr. Stonehill put it this way, "We can use technology to affirm the things that we've done in the classroom, or we can use technology to advance the things we're doing in the classroom. I'm stuck sometimes on just affirming

it. I fail to push it along sometimes to advance some goals." Evan modeled the pushing ahead practice in his classroom with the Virus simulation activity, and also reflected on the experience in a similar way he asked his students to reflect. The instructional practice of reflection and debriefing was becoming a natural response in our conversations as well. Here are some of Mr. Stonehille's thoughts about the value and impact of using simulations in the classroom,

> "You know all that (sic) simulation packages are the things that allow kids to become part of something, get them thinking about something – and then process. And that whole process piece is what's probably important, as far as, not only getting them to think but also furthering their thinking as well. It's the whole deal with heterogeneous grouping that you have some kids who are moving the ball a little farther because they have ideas to be able to share.
>
> In some of the interaction that took place Josh was sharing, he was still kind of working it out while we where still processing, and I think got it in the end. He knew that some people were not going to be sick, some people were carriers, some people were people that certainly are going to spread the virus but yet just

> because you spread the virus doesn't mean that you're necessarily going to get sick – and he was one of them. So, that was good to hear, and he then hopefully, furthered the thoughts of other students that were there as well.
>
> I like that particular handheld piece because it simulates something that, 1) we've read about when we read Fever 1793, but 2) I also like it because it's very topical. And it's topical with the pandemic talk about the Avian Flu, it's topical with regard to any kind of illness or we could have led the discussion further into behavior, society behaviors. Or they're going on to middle school and people have abhorrent behavior, what do you do? We chose not to because of time. Just because it's called Virus doesn't mean it has to be that. Viruses can take many forms instead of illnesses.

His continued reflection led him to consider the higher order thinking skills needed to reach the higher levels of integration in the Levels of Technology Integration (LoTi) framework:

> I think sometimes teachers with technology are just happy sometimes, 1) that they can use it, and they see using technology in some way as an end result; and don't even consider that you

could use it for more than that. So there needs to be some catalyst – you were my catalyst. And is was simply through the LoTi survey that triggered something. I said, oh, I never thought about using technology in that way. So as far as a staff development model: 1) I think there needs to be some kind of catalyst that gets people to do it; 2) I think there needs to be a number of examples and models that help people to be able to see that happen. To get a bunch of teachers together and play Virus, and then get then hooked. And those pieces aren't just on handhelds, they're on lots of different things.

I've seen more and more software through the internet. Not just the software pieces you can buy, but through Java applets, you know, it's just incredible. The number of math manipulations packages that are out there – that truly – you know, they're doing problem solving. Kids love to play Lemonade Stand, which is a fifth grade favorite, but there are some other pieces there that are just amazing as far as pure math thinking. That's good stuff. And that to me is a way to further things along.

Research Question Two

How can the Levels of Technology Integration (LoTi) framework assist in the process of ongoing learning and goal setting?

The Levels of Technology Integration (LoTi) online survey results presented the dichotomy between teacher participants' comfort level with technology use and beliefs about student-centered learning compared to their integration efforts in a very compelling way. The combination of this shock and the opportunity to discuss its implications for instruction are at the core of the professional dialog that frames the heart of this study. Mrs. Foster and Mrs. Norman both implemented cooperative work that was focused on a performance task. Mrs. Keaggy used more traditional assessment strategies that included the "piling on" of technology tools. Mr. Stonehill included an open-ended, inquiry activity that raised the level of thinking skills being used in the classroom. The fundamental differences in the teachers' approach to student learning was observable in many of the classroom interactions witnessed during field observations and interviews conducted by the researcher.

Several key themes emerged within this research question. Teachers Considered Their Instructional Practices (both practical aspects and underlying beliefs); the survey results became a Catalyst For Reflection and Action; and participants included an increased focus on Higher Order Thinking Skills when designing instruction and assessments.

Teachers Considered Their Instructional Practices

The LoTi survey results presented the dichotomy between teacher participants' comfort level with technology use and beliefs about student-centered learning compared to their integration efforts in a very compelling way. The combination of this shock and the opportunity to discuss its implications for instruction are at the heart of the professional dialog that frames the heart of this study. Mrs. Foster, Mr. Stonehill, and Mrs. Norman all implemented cooperative work that was focused on a performance task. Mrs. Keaggy used more traditional assessment strategies that included the "piling on" of technology tools. This fundamental difference in the approach to student learning was observable in many of the classroom interactions and interviews conducted by the researcher.

When Mrs. Foster's third grade students were interviewed about the role computers played in helping them attain their learning goals in math and science responses included, "it really helps", "it was very helpful", "I used spell checks", "it's more fun to use computers", "it will help you with your spelling, and your hand-eye coordination", "a computer will help you with your typing, and sometimes your handwriting", "you can learn about things on the computer", "it's funner (sic) to use a computer", "I'm not sure, but I think it can help you start thinking more about your work." "On paper it's the

same, but it's more fun on a computer because you get to click. I like the computer a lot." One student contrasted the computer with a pencil and noted, "it kinda gives me more energy in my fingers, so I can type more."

When students were asked, how did technology help you get better with your math skills? One boy interviewed offered this explanation, "It (*the computer*) would give you a problem and if you missed it, it would give you the answer but then it would give you that (*kind of*) problem again." Another student hesitated when responding to the same question, looked at the researcher and finally offered, "it helped me, a little bit. There were a bunch of multiplication facts we could answer." A female student exclaimed, "I think it's a great way to learn stuff, and you can have fun on computers – like you can play games. I'm glad that we have computers." One student who was thought the concept of symmetry was "kind of tricky" said, "the computer helped me understand. If you got it wrong they would explain it to you, and show you how to use it." She went on to add, "usually it just tells me the answer, but this morning it told me what to do."

Responses to the use of computers for their animal adaptations project research and presentation included, "you go to a web site and it would give you facts about your animal", In response to a limited set of keyboarding skills one student offered the conclusion that for her it was, "easier to just

write it down." One student commented on the connection between her animal project and a pet she was getting at home, "it helps me learn about a lot of things" she reflected.

One student summed up his use of computers in Mrs. Foster's room with this observation about computer use and his thinking, "It challenges you to think sometimes, and other times it's kind of easy." While the student was unaware of any criteria associated with the LoTi Framework, he was keenly aware that some of his computer use was linked with very low levels of creativity, higher order thinking, or creative problem solving. Another student described some of their most complex thinking when describing how spell checks were valuable during the animal project. She said the letters were sometimes "so far off that the dictionary didn't know what word it was" and by "adding letters" she worked with the spell check feature to figure out what the correct spelling was.

The Levels of Technology Integration (LoTi) online survey results caused a direct and immediate reaction that allowed each teacher to examine their own use of technology as part of their regular and routine planning and instruction. Overall student use of technology was not mentioned as a justification for the relative absence of technology integration in these teachers' classrooms. Each participant realized that rich learning is available when the technology comes to the classroom. Technology coming to the learning environment is far richer than an interruption of the learning to

visit a technology-rich environment. The results of the Levels of technology Integration (LoTi) online questionnaire played an important part in causing teachers to re-examine their own beliefs and practices concerning the role and routine use of technology in the regular classroom.

Catalyst For Reflection And Action

The unanimous reaction to the initial Levels of Technology Integration (LoTi) online survey results was one of reflection. Each participant experienced some aspect of mild shock when the compared their high Personal Computer Use (PCU) score with their relatively low overall LoTi score.

Evan expanded on the connection between the Levels of Technology Integration (LoTi) online survey, coaching and goal setting when he reflected on the inclusion of higher order thinking skills for his ongoing lesson designs:

> I think sometimes teachers with technology are just happy sometimes, 1) that they can use it, and they see using technology in some way as an end result; and don't even consider that you could use it for more than that. So there needs to be some catalyst – you were my catalyst. And is was simply through the LoTi survey that triggered something. I said, oh, I never thought

> about using technology in that way. So as far as a staff development model: 1) I think there needs to be some kind of catalyst that gets people to do it; 2) I think there needs to be a number of examples and models that help people to be able to see that happen. To get a bunch of teachers together and play Virus, and then get then hooked. And those pieces aren't just on handhelds, they're on lots of different things.

Melinda reflected on her diminished use of technology for higher order thinking, and expansion of her curriculum. Several years prior to the study she was in a different building and used the internal local area network (LAN) as a resource to publish student writing for critique from other staff members. Her students didn't stop at word processing, but instead they communicated with an expert to revise, edit, and improve their writing. Melinda wondered if the creation of a Technology class for each classroom had influenced her, and others, to relegate the work of integration to another staff member instead of working for rich connections from within her own classroom experiences.

The researcher noted similar conversations concerning the once-a-cycle technology class with the other elementary teacher who participated in the study. The secondary teachers have students who do not share the same kind of technology class schedule as the elementary students, although the

curricular strands that are established for technology courses at the secondary level can arguably have the same end result – a shift of technology use from the general classroom to the specialists' room. Louise cited this indirectly when she voiced her frustration of how difficult it was to find an empty lab for her math students. The primary reason the labs are filled is related to the business education, internet research, and media classes that are regularly scheduled for these technology-rich lab classrooms.

Higher Order Thinking Skills

The Levels of Technology Integration (LoTi) levels provide a clear path for improvement. Participants were able to identify the inclusion of higher order thinking skills and authentic performance tasks as the two key areas for boosting LoTi Levels in their learning goals and instructional designs. Participants were comfortable with their understanding of performance tasks, and realized the difficulty in creating authentic tasks at their grade level and subject area. Higher order thinking skills, however, were seen as a missing aspect of their current practice whose addition could immediately boost the richness of their integration.

Mr. Stonehill decided to explore the learning goals he established for his students through the use of participant simulations using Palm™

handheld computers. His students had ready access to these tools because they were one of the fifth-grade classrooms in the school district piloting the use of handheld computers. Mr. Stonehill and his students had been working with handheld computers for three years. The implementation of the handheld computers was not as a class set, but in a one-to-one model. Each student was assigned a handheld computer that they would use at school, or at home, during their academic year. Students were responsible for the care of the unit, and the management of the data contained on their handheld computer. Because each student had a handheld computer it was possible to pursue the use of real-time simulations for learning. Mr. Stonehill decided to use some of the simulations for Palm OS handhelds developed by the Massachusetts Institue of Technology (MIT). Their software is available at the MIT PDA Participatory Simulations Site, http://education.mit.edu/pda.

MIT staff describe participatory simulation software by explaining, "PDA Participatory Simulations use Palm OS handheld computers (for now only Palm OS is supported) to embed people inside of simulations. Interactions between players in the game are mediated by peer to peer beaming. Our games are based on work that we have been doing at MIT for several years using custom wearable computers."

The simulation chosen to use with the class was Virus. Excerpts from the instructions describe the game environment this way, “Players in this game are told to meet as many people as possible without getting sick. You can only meet each other player one time. The catch is that no one knows how you get sick. There are many parameters that you can set in this game. In order for the game to work well you will need to create three kinds of people - Regular, Immune and Patient Zero.”

Students played the game with intensity and often reacted strongly to the threat, or virtual outbreak of a virus. The gameplay usually lasted about twenty minutes, and debriefing to follow up on aspects of the simulation took another ten or fifteen minutes. The level of higher order thinking in this open-ended environment was at a noticeably higher level than the thinking demonstrated in a the more commonly found, skills-based use of computer games in math, literacy, and other curricular areas.

Students observed during the playing of Virus were using high levels of student talk including questions and comments such as, “I don’t think I want to meet with you”, “Why didn’t you get sick after you met with Ken?”, “Why can you be well when me met all the same people?”. Of course the immediacy of the simulation also produced reactions like the student who covered their handheld with their hands and pulled it close to their torso so no

one could beam them and potentially infect them. A more drastic response like a shriek and "get away from me" as a student hurried across the room was observed in almost every round of the simulation. Students clearly became deeply engaged with the simulation environment as both the technology and the learning goals became invisibly dispersed throughout the classroom.

Mr. Stonehill sensed the power of the learning and thinking when he commented that, "I think kids learn best when they have an opportunity to understand and reach learning through the back door. That's most memorable to them when they can construct their own learning." He also realized the difference that one-to-one, portable, ubiquitous computing can make by observing that, "Handhelds provide that opportunity. It allows them to play educational games that would have them think better. It allows for the opportunity to make learning personal for them, and when they can do that they understand what it is that they're learning, and it helps them to learn in other areas; transferring the skills that they're able to see and know with their handheld to other mediums in which they'll be able to learn in a new way." Mr. Stonehill implemented a set of student learning goals that demonstrated his high comfort use with technology, and beliefs about student-centered learning. These aspects of his lesson deign align with the results of the LoTi

survey pretest, especially the Personal Computer Use (PCU) score of six and the Current Instructional Practice (CIP) score of four.

Research Question Three

How does the construction of a digital story affect the meaningful integration of technology with student learning?

Participants in the study did not complete the Digital Story as expected. The salient aspects of the digital story where apparent in the focus group session that ended the data collection phase of the study. The salient aspect of the digital story is reflection on current practice, and coming together for conversation about the experiences they shared during the study provided a very rich arena for reflection and connection to future practice.

Themes that emerged relating to this research question are: the way Digital Immigrants collaborate; and the Institutional Expectations regarding ongoing learning related to daily practice.

Digital Immigrants

Only one participant expressed a comfort level with the online environment established for collaboration and reflection among study participants. Her past experience with these kinds of tools for the purpose of political discourse was a factor in her comparatively high comfort level when compared with other participants. The digital story did not disappear, but became evident in the discourse when participants assembled for reflection

and discussion. Each had a story to tell of their personal transformation regarding the integration of technology. These stories were no digitized and produced as finished projects for the screen, instead they were woven in the conversation in a way stories might be shared around a campfire, or dinner table,

Participants shared openly about their technical frustrations, limited access concerns, and technology triumphs – but in a way that suited the digital immigrant. No real data was collected from the CRTeacher.com web site that was established by the researcher for electronic collaboration. This site was intended to be the ongoing, electronic journal and documentary of the participants' experience. These insights were revealed in the data, but in ways that the researcher did not anticipate.

Institutional Expectations

The expectation of a digital story was more than the culture and climate of the institution could bear. The six week time period was also a factor that influenced the rejection of the digital story. Reflection was the key component of the digital story, and reflection emerged as a key theme in more than one research question. This supplanting of the digital story leads to a key finding for this research question. Teachers, influenced by the organization and

setting in which they function, have come to regard the completion of performance tasks like the digital story as appropriate for graduate study, but unattainable in the confines of schedule, time, and materials available in their day-to-day routine. The researcher realizes that in putting forth a new model for professional learning the components must align with what is considered attainable in the day-to-day routine. More data related to this aspect of the study are shared in themes from research questions 1, 1c and 1d.

Research Question Four

What kinds of social contexts assist in the construction of richer learning environments for students?

Despite the fact that each teacher participant scored a Level Six on the Personal Computer Use section of the LoTi Questionnaire they were reluctant to use the online collaborative space the researcher created to build a virtual community of practice. Some of this might be explained with the broad number of ways to be using technology. In other words the teachers were highly skilled and comfortable with existing practices around technology use (email, file management, multimedia production, etc.) but they were not nearly as comfortable or confident in their ability to use emerging tools for social collaboration available on the internet today (wiki, shared writing via blogs, social software like de.licio.us, etc.).

Themes that apply to this research question are: teachers receiving opportunities for Coaching; individual and group Reflection on Practice; a context bounded by Clear, Common Expectations; and settings that allow ample Face-To-Face Interaction.

Coaching

The researcher anticipated the creation of virtual collaborative environments to have a positive impact on participants' interaction, but the findings demonstrated that the one-on-one coaching opportunities while completing the Levels of Technology Integration (LoTi) online survey,

planning instructional goals, doing field observations, and while conducting interviews made a strong contribution to the level of integration going on in the participants' classrooms.

The dialog exchanged during the one-on-one coaching opportunities often included discussion about the role of technology in students' lives outpacing the role of technology for learning at school. This cultural and contextual focus helped participants talk about a tension between their current integration practice and the kinds of learning environments that could be created with technology.

Reflection On Practice

The face-to-face session, limited electronic responses and informal conversations with participants all included a frequent reference to a change in practice that was either desired or occurring in their classroom. Some of the language contained in the clear criteria set out by the Levels Of Technology Integration (LoTi) framework (like, exploration, collaboration, and higher order thinking) was echoed in participants' comments. Other insights were an obvious outcome of their comparison of past practice with the goals they had formally, or informally, set for their routine practice surrounding integration. Melinda, for example, remarked,

> Yeah, it's (using computers) great for writing workshop, or to keep children on a task. When they got tired of doing it one way I could change it up and differentiate using technology that way. It was interesting to note that three years prior I was using technology better because we didn't have the technology special and I thought to myself, that was an eye-opener. And I'm glad I looked at it that way because you know, I was doing some higher level things. I was doing book reviews and having them on the intranet, inside the school system, and I asked people to respond to what the kids where doing so I really was doing a lot more interactive stuff so I thought to myself, gosh, why have I stopped doing that?

Interestingly, one of the activities Melinda included near the end of the research study was an online webinar with an author/illustrator involving her whole class. She not only observed a current gap in her practice, when compared to previous practice, but made a short-term goal to adjust her instructional planning to include more interaction and a broader connection to experts using technology. She improved her level of integration by returning to a type of practice that used to be a part of her instructional plan. The recursive nature of the event does not go unnoticed. She became involved with a social context (the study participants) to reflect on practice which led to the inclusion of a more social context in her use of technology with students.

After reflection Mrs. Norman realized the power of the class web site as a support to learning beyond the classroom walls. She decided that a goal for an upcoming year would be to actively advertise the site and it's resources whether it was used during class time or not. Her comments included a sample explanation, "Here's my site. Here's what's on the site. Here's what you can get from the site. And to bring it (*ed. web site*) up more. Not that that's the focus of the class, but I think it's wonderful…if they're confused they can click on the button and here's the example, here's the definition." Again I mention that these kinds of connections between math and technology resources align with the low LoTi Level score received during the pretest portion of the study.

In response to the web site support students commented, When contrasting the answers in the back of a textbook with the process of computer tutorials one female student preferred the computer environment because, "It give you the steps of how to get to the answer." When the researcher questioned if she had ever "worked backwards to understand an answer" here response was, "definitely." Another student preferred to use computers in math class because, "it's easier to see" but the same student didn't like the fact that solving the equation meant she had to "copy it down on another piece of paper and then solve the problem." Compared to a computer a

textbook, "sometimes in your textbook it doesn't explain the whole process of doing it, and it doesn't give you the correct answer at end so you can check your answer." When letting the computer solve a difficult problem the student can, "see what I did wrong." After using the class web site for a test review a student commented, "I actually understand it better now."

Clear, Common Expectations

The Levels of Technology Integration (LoTi) framework provided a clear and easily communicated set of criteria for instructional improvement regarding the integration of technology. Integration is a complex task, and often accompanied by uncertain, or completely absent, criteria of how quality integration is described. The Levels of Technology Integration (LoTi) framework provided a clear description of integration at eight discrete levels; allowing participants to continuously self-assess their practice against a delineated set of criteria as they work toward constant improvement.

These participants volunteered to be a part of a research study involving the integration of computers. The interest in the concept was already in place. Part of the reason they improved practice during this six week period can be attributed to the clearer picture they received about their ideal practice. Criteria itself is only the starting point. Conversation to clarify, refine and make meaning from the criteria and the reflection that compares

that new understanding with past practice are the levers that move criteria from notion into practice. But the existence of clear criteria should not be understated.

While the Levels Of Technology Integration (LoTi) framework is a valid, reliable, and high-quality set of criteria it's the existence of common, clear description that is at the core of this finding. Participants lacked a clear understanding of high-quality integration until they considered a set of measured criteria to help them actualize ideas and progress toward a high level of instructional practice. As participants in this research study they were clear about the connecting of integration expectations with the levels described in the LoTI Framework. The study expectations exceeded the prevailing cultural belief that diminished the notion of integration to mean any use of a computer during regular classroom instruction.

Face-To-Face Interaction

Real-time, face-to-face action was preferred by our digital immigrant teacher participants, but even the digital native students in Mrs. Foster's third grade class seemed to prefer interaction that used technology to bridge distances in real-time. Mrs. Foster's students were highly engaged while attending a web-based presentation by author and illustrator Peter Reynolds. Third grade students who were often restless in the classroom setting were attentive for more than 45 minutes while watching a webinar that was

projected to a screen for a large-group presentation. Quality of the audio, video, and presentation slides was good, but not excellent. Despite the constraints of the web-based format the students were attentive, and responded when prompted to ask questions of the presenter (via a text chat). This activity happened at the end of the research period and the researcher was not able to interview any students for their comments concerning the webinar.

Teachers resisted the use of online collaboration despite the fact that each teacher participant scored a Level Six on the Personal Computer Use section of the LoTi Questionnaire. They were reluctant to use the online collaborative space the researcher created to build a virtual community of practice. Some of this might be explained with the broad number of ways to be using technology. In other words the teachers were highly skilled and comfortable with existing practices around technology use (email, file management, multimedia production, etc.) but they were not nearly as comfortable or confident in their ability to use emerging tools for social collaboration available on the internet today (wiki, shared writing via blogs, social software like de.licio.us, etc.).

Despite high Personal Computer Use (PCU) scores by each of the four participants there was an observable, and stated objection to the use of online, collaborative tools for group interaction. Participants stated a lack of comfort level with these emerging tools. Louise disliked the asynchronous nature of

the online tools and offered a specific example, “When you blog or you email you have to wait for the response”. Louise continued with an example of common experience during face-to-face conversation, “So if there’s something that Evan says I can respond immediately and even clarify something”.

Evan comments concerning the use of these tools was insightful, and met with head nodding and verbalizations as the other participants agreed with his observations,

> I view myself as fairly open to technology, yet I’m still somewhat resistant to go online and offer comments or start some kind of online dialog. Simply because I guess I’ve lacked some exposure to it. And I consider that it would take some time to be able to have that happen. One of my favorite sayings is that change is a process not an event. I think it would take quite a process to have that be able to happen, but it doesn’t necessarily mean that it shouldn’t occur.
>
> I think sometimes it’s ones’ own personality as well, it’s their conversation style, it’s how they like to learn, it’s how they like to share ideas. I’ve often considered, do I want to teach an online course? And in the end I’m not really sure that I want to because I enjoy meeting with people, talking with people, that’s my own

> style of being able to share and also to learn as well. So those opportunities night work well for some, and not as much for other people.

During further discussion teacher participants began to formulate possible solutions to their shared lack of ease concerning emerging tools available through blogs or wiki pages. Evan summarized several minutes of the groups' conversation when he suggested:

> Well the next step then is videoconferencing, it's the natural next step. Basically now we're going from the difficult piece, for me , about blogging and checking our writing, something that seems much more formal, to our latest discussion – chatting online. And now you just mentioned about the face-to-face. The next part is to think, well now you can be face-to-face doing some kind of web conferencing.

Research Question Five

How can we explain the limited integration of technology with core curriculum despite generous access to technology resources?

The idea of generous access may have to be examined in light of one-to-one access. Seymour Papert mentioned this as a key aspect of M.I.T. Media Lab's one-hundred-dollar-laptop initiative, and the researcher was able to observe an authentic difference between the handheld using fifth graders (one-to-one access for the year) and every other classroom. Regardless of the one-to-one aspect there is a disconnect between the notion of availability and the actual availability of technology resources – especially at the secondary schools involved in the study.

Major themes emerging related to this research question include: the lack of systemic expectation surrounding the importance and use of technology resources; the day to day access to technology tools available to the classroom teacher; and a lack of clarity and criteria describing what quality integration looks like at the classroom level.

Lack Of Systemic Expectation

Until the study participants volunteered for this research they had no formal expectation that technology would be included in their lesson design.

Neither a grade-level, building-level, or district-wide expectation existed about the use of technology. The scheduling of a technology special at the elementary school and the strong curriculum strands of technology offerings at the secondary schools have helped to foster an attitude that eliminates the urgency of integration from the regular classroom. Technology is not seen as a way of knowing, doing, and learning, but as an extra item to be added to the classroom. Lack of a unified, systemic expectation perpetuates the belief that technology is not a necessary component for relevance or meaning in a students' learning environment.

Access To Technology

The idea of generous access may have to be examined in light of one-to-one access. Seymour Papert mentioned this as a key aspect of M.I.T. Media Lab's one-hundred-dollar-laptop initiative, and the researcher was able to observe an authentic difference between the handheld using fifth graders (one-to-one access for the year) and the other classrooms in the study. The LoTi level of instruction taking place in Mr. Stonehill's room while using handheld computers was at the 4b level. No other classroom observed reached the 4b level during the study period. Although other factors, such as the

instructor's constructivist style, contributed to the overall LoTi level, but the difference observed during the data collection bears noting.

Even in an upper middle class, suburban school system the actual access to technology resources was very limited. Lesson planning that must anticipate scheduling of shared spaces (labs), or limited portable resources (laptop carts) is inherently flawed compared to the "take the technology to the learner" model identified in one-to-one computing environments. Field observations in Mr. Stonehill's classroom support the power of the one-to-one model. As long as we are moving the learning to the lab we will experience a frustration with the process and resulting student products.

Mrs. Norman articulated a general experience that several participants shared when she reflected on her past practice with regard top technology use:

> Initially I didn't get involved (with use of technology) because we have forty minute periods, and we have a massive amount that we have to teach. I don't want to use the words, get through, because I don't like those words, but just a massive amount that we have to get them to understand.
>
> So just the logistics of getting to the library, or getting the computers here – will they be available? Will the computers work? Most of the time they do, but the one or two times it

> doesn't then that kid has had a frustrating experience – as opposed to what I'm looking for which is an excited, um, progressive thing. You know?

Clarity Of Criteria

Similar to the lack of systemic expectation, this theme recognizes the importance of describing common targets for integration efforts. Clarity of criteria acknowledges that systemic expectation is not enough, but a starting point to be clarified by a well-crafted set of criteria that describe a high-quality integration experience. The Levels of Technology Integration (LoTi) online survey was a catalyst for reflection, but the framework described by LoTi provided a clear and understandable progression toward excellence in the use of technology for learning. Without undertaking any formal class sessions or additional readings each participant was able to develop a next step, or long-term goal, for their use of technology based on the LoTi level descriptions. This clear criteria provided a common language as coaching took place, and when participants had opportunity for face-to-face interaction.

Mrs. Norman's LoTi scores in the pretest were tied for the highest results in both the Personal Computer Use (PCU) and Current Instructional Practices (CIP) sections with scores of six and four respectively. Her overall

LoTi level, however, was the lowest of any participant in the survey – Level One. This Level One score was aligned with concerns about the potential problems, limited access, and use of instructional time made evident in comments about the use of technology during math class. "That's the biggest thing for me. What tangible evidence do you have that they've done what they've supposed to have been doing during that time, as opposed to off looking at another site, or something?" She continues as she wrestles with a conclusion to the perceived dilemma, "So the best way I can come up with is something that they have to put on a piece of paper and bring back to me. So it at least tells me that they've been through the examples, they tried the little online quizzes and such, and it does keep them focused on a specific task." While the researcher offers no debate about the need for a sharp instructional focus, especially for middle level students, these comments point to the broad disconnect between Mrs. Norman's beliefs about student-centered learning, her own use of computers and the type of learning environment she routinely designs for her students.

Mrs. Norman asked a student of the test review session using online drill software was fun and the student responded, "as fun as math can be" without much enthusiasm of facial expression. Does the limited engagement level of the task overshadow the draw of computer use for this student? Mrs.

Norman perceives the introduction of computers as the only needed component to make math more fun. "I do think math can get boring on occasion. As much as I love math – (said sarcastically) and I can't understand why they think it's boring. But, it does get boring for them. So when you change it up, when you give them a different medium to use I think it makes it fun."

She does believe in the power of student engagement and commented on the role of expectation and engagement in the classroom, "I think a lot of times kids don't do well in a class because they don't like the class, or they don't like the teacher, or whatever. But, if it's a class that they look forward to – just on the basis of what you do in there, and not necessarily because they love math – but they do well because it's an interesting class."

Systemic expectation was discussed earlier in this section, but even when an individual teacher and classroom overcome the lack of systemic expectation the quality of instruction, and LoTi Level of resulting integration efforts can falter when criteria is not considered. For example, later in the research study Mrs. Norman collaborated with a social studies teacher in the building to have her students participate in a WebQuest activity. The WebQuest framework is a specific deign to engage students in higher levels of thinking by using web-based resources to struggle with a rich question. The

use of multiple perspectives, open-ended questions, and a focus of using information to create new understanding - as opposed to reporting information – distinguish the WebQuest model from other forms of internet-based activities. The WebQuest used by Mrs. Norman's students was, like many others, a WebQuest in name only. The task of the quest was a low-level reporting of facts gained while investigating a trip to a major league sporting event based on a budget for travel, gas, food, and miscellaneous items. Students were placed in small groups to complete the online portion of the quest (mainly gathering pricing information) and required to create a PowerPoint presentation to share their findings with the class in an oral presentation.

Students' responses to the WebQuest and presentation assignment included, "The whole purpose of the WebQuest is to show us how to use money." The use role of technology in the project was relegated to, "find out gas prices, hotel prices, everything. For food, we already knew what that *(ed. cost)* was." When asked what was unique or helpful about using technology the response related to the presentation instead of the quest. One female student noted that, "we could animate it" in reference to her PowerPoint slides.

While great time and effort were expended to create an instructional atmosphere that included the use of technology tools the resulting WebQuest experience was not as strong as it could have been. In an effort to include the use of computers, small-group collaboration, and authentic assessment - which are all noble aspirations – the overall thinking level of the project was not given adequate consideration. Mrs. Norman and her partnering teacher were unaware of any building-level or district-level, support to define, enrich, or evaluate the use of WebQuests in the classroom. Therefore, it was left open to the individual interpretation of two teachers. With the logistics and curriculum issues already needing to be considered it's easy to see how the criteria for a rich webQuest could be overlooked.

Summary

Themes that emerged from analyzing the data collected during the study show the complex relationships of many aspects of the schools' operation, history, context, and culture. Culture and Context is the factor that all other themes interact with and against. Coaching; Self Evaluation; LoTi Goal Setting; Examination of Instruction and Beliefs; Reflective Action; Higher Order Thinking Skills; Digital Immigrants; Reflection; Systemic Expectation

and Criteria; and Access to Technology all emerge in relation to the context and culture.

Participants lack a way to be introduced to rich integration practices in gradual, manageable steps where they can have success and build competence and understanding. They must have ways to bring their current level of integration practice and understanding to an authentic instructional episode before they are masters of integration practices. Legitimate peripheral participation is only available if a new teacher receives a mentor who possesses the skills and understanding related to the practice of integration. All others are left to fend for themselves. While experiential learning is not to be diminished as a path to knowledge building, the common practice of enhancing learning with technology cannot be left to the occasional "good fit" between a tech savvy teacher and a mentor who is an expert integrator.

In order to guide this process of gradual growth, mentoring, and modeling a clear set of criteria is needed. The Levels of Technology Integration (LoTi) framework is a well-crafted, valid, and reliable set of criteria that describe eight discrete levels of integration performance. Without a clear understanding of integration practices the technology will likely become and end in itself. A skills-driven model of technology competencies is not sufficient to reach the high quality integration experience articulated in the upper levels of the LoTi framework. Ongoing learning necessary to create this culture of participation is far more difficult to create and sustain than a skills

checklist, but the findings of this study indicate that such a culture and climate is attainable with a focused effort that includes coaching and collaboration.

Chapter Five: Summary And Discussion

This chapter includes a summary of the study, research methods used during the study and results. The final sections of the chapter include the researcher's conclusions based on the data collected during the study. Significance of the findings and implications for research and practice in the field of K-12 Education and recommendations for continued research are also discussed.

This final chapter is more than a summary of the preceding work. The researcher follows Silverman's (2005) suggestions to discuss the relationship between the work done, the original research questions, previous work discussed in the literature review chapter and any new work appearing since the study began. The researcher describes how theories have helped to make meaning of the data and describes how aspects of the study may be done differently.

Summary

The study took place in a suburban, public school in Pennsylvania. A qualitative research design using case studies from four elementary and secondary classrooms provided opportunity for the researcher to be an active

participant in the research and data collection. Data were gathered using field observations, formal and informal interviews, videotaping, online questionnaire, and artifacts. The primary sources of data being the interviews with teachers, and the teachers' Levels of Technology Integration (LoTi) questionnaire results. The data collected led to insights and connections that allowed the researcher to richly describe the context and process surrounding the ongoing integration of technology for student learning. Data collected allowed the researcher to analyze the implementation of the technology integration process at many levels of the organization.

The purpose of this study was to investigate how teachers reflect on their learning designs, practices, and student learning through digital storytelling. The case study also sought to discover how reflection through the creation of digital stories might influence teachers' ongoing learning design and practice. Key factors that surfaced during the study are, Culture and Context; Coaching; Self Evaluation of current integration practice; setting a Levels of Technology Integration (LoTi) Goal for lesson/unit planning; and examining current practice through Reflection. Each factor represents an important part of the process when connecting existing curriculum and technology.

As illustrated in Chapter One, traditional models of staff development have failed to produce satisfactory results in the integration of technology

with student learning. New learning is being delivered in the same ineffective ways that failed to produce transformational change. Although access to educational technology is often plentiful and models of effective technology integration provide a rationale for its practice, technology integration has failed to become a common classroom practice for a majority of teachers (Casey & Rakes, 2002; Moersch, 2002). These findings suggest that efforts to train and motivate teachers to integrate technology have been largely unsuccessful. Teacher learning is stuck in this ineffective model while the pace of ongoing learning continues to accelerate (Becker, 2000; Casey & Rakes, 2002; Harper, Squires, & McDougall, 2000; Lewis, 2002; McKenzie, 1999; Robb, 2000; Sparks & Hirsh 1997c). To address this problem this study examines the following questions:

1) What kinds of ongoing learning appear to facilitate the integration of Technology with core curriculum?

a) How can the Levels of Technology Integration (LoTi) framework assist in the process of ongoing learning and goal setting?

b) How does the construction of a digital story affect the meaningful integration of technology with student learning?

c) What kinds of social contexts assist in the construction of richer learning environments for students?

d) How can we explain the limited integration of technology with core curriculum despite generous access to technology resources?

This study used a case study model with four teachers in four different elementary and secondary schools in a suburban setting. Methods used by the researcher were primarily qualitative, but some quantitative data were also collected and used. The teachers set integration goals and designed learning environments to integrate technology skills and resources with their existing curriculum.

The researcher observed teachers and students, conducted formal and informal interviews with groups and individuals, and collected artifacts from teachers, students, and the physical setting. The research was conducted over a six week period during April and May of 2006. Evaluation of the quality of integration was based on the Levels Of Technology Integration (LoTi) framework and the National Educational Technology Standards for Students (NETSS).

Table 7 is a visual representation of the themes that emerged from the analysis of data. Key themes emerged in each of the research questions. The themes shown in Table 7 will be discussed in this chapter.

Table 7 – Research questions and themes

Research Question	Themes From Findings
1. What kinds of ongoing learning appear to facilitate the integration of Technology with core curriculum?	- Culture and Context - Coaching - Self Evaluation - Levels of Technology Integration (LoTi) Goal - Reflection
1a. How can the Levels of Technology Integration (LoTi) framework assist in the process of ongoing learning and goal setting?	- Teachers Considered Their Instructional Practices and Beliefs - Catalyst For Reflection and Action - Increased Focus on Higher Order Thinking
1b. How does the construction of a digital story affect the meaningful integration of technology with student learning?	- Digital Immigrants' Collaboration - Institutional Expectations
1c. What kinds of social contexts assist in the construction of richer learning environments for students?	- Coaching - Individual and Group Reflection on Practice - Clear, Common Expectations - Face-To-Face Interaction.
1d. How can we explain the limited integration of technology with core curriculum despite generous access to technology resources?	- Lack of Systemic Expectation - Access To Technology - Lack of Clarity and Criteria

Conclusions: Culture And Context

The culture and context presented barriers to the practice of high-level integration of technology and professional interaction – barriers that prevented communities of practice from forming or being effective. If the use of technology is going to progress toward higher levels of the LoTi framework it will need to be assisted by a culture of common practice, and shared expertise. Knowledge required to accomplish this systemic shift is found in an organization, not in individuals. Data collected during this study represents a lack of community knowledge needed to move integration practice ahead with any substantive gains.

Melinda noticed a change in the way she used technology at a building-level and wondered what had caused the shift,

> It was interesting to note that three years prior I was using technology better because we didn't have the technology special and I thought to myself, that was an eye-opener. And I'm glad I looked at it that way because you know, I was doing some higher level things. I was doing book reviews and having them on the intranet, inside the school system, and I asked people to respond to what the kids where doing so I really was doing a lot

> more interactive stuff so I thought to myself, gosh, why have I stopped doing that?

Without identifying a cultural component by name she had intuitively seen the shift that had occurred when teachers' classrooms, including her own, no longer functioned as the epicenter for technology integration work. Outsourcing the work of connecting curriculum and technology had created a huge shift in the expectation, and routine instructional practice of her classroom.

Results indicated that key factors influencing the successful implementation of high quality integration in teachers' instructional practices are well aligned with previous research presented in the literature review of Chapter 2. Of particular note is the work of Lave and Wenger (1991) with regard to the opportunity for legitimate peripheral participation opportunities for teachers. The institutional quality of the K-12 system reinforced attitudes, beliefs, practices, schedules, and logistical limitations that made high-quality technology integration difficult to attain on a regular basis. These tangible and intangible factors culminate in a context and culture with little or no opportunity for teachers to become a community of practice together. The success of meaningful integration is left almost solely to the pioneer teacher who is already comfortable with risk, innovation, and reflective practice.

While teacher volunteers for this research study displayed many of these attributes at higher levels than their peers each benefited from the opportunity to form a small community of practice during the period of the research study.

The culture of embedded staff development was also at work in the research setting. Some aspects of the research design such as online tools for collaboration and reflection, or the use of digital video editing for a digital story, were discarded by participants –in part – due to the tacit beliefs concerning what is acceptable work for staff development. These elements might have been embraced in a graduate course, but were viewed almost immediately as unattainable within the time and schedule constraints of the K-12 system. These elements of the research design were introduced to address the prevailing call of literature discussed in Chapter 2 to create new models for staff development. Discussion later in this chapter will clarify the rich contributions that online tools and digital story made to address the research questions of this study, but the unexpected finding is just how strongly the culture and context overrides the expectations and eagerness of even the most enthusiastic volunteers. If the teacher participants in this study were unable to embrace the online tools and digital story it's unlikely that any teachers in this K-12 system would.

Conclusions: Surprising Result

Participants recognized the results of their online questionnaire as an important, and surprising "jumpstart" in their decision, and motivation, to engage in the process of reflective practice. Each participant remarked about some aspect of the survey result as an important component of the process in their journey.

Part of the context discussed in the previous section that impedes the widespread adoption of high-quality integration is the generally held belief that technology integration is one more thing that must be added on to an already-full plate of items a teacher must accomplish with their students. This leads to a belief expressed by several of the participants that a lack of integration in their particular setting might be offset by work students accomplish in a separate, technology-rich setting like a weekly visit to the computer lab in elementary school, or a keyboarding or Microsoft Office course for secondary students.

The Levels of Technology Integration (LoTi) online questionnaire provided valuable data for the researcher but the quantitative data were not the key element of the instrument. More specifically the quantitative data required further description. Each of the teacher participants experienced survey results that indicated a large gap between their own comfort level with

technology, the Personal Computer Use (PCU) score and their current level of integration, the Levels of technology Integration (LoTi) score. This result marked the Levels of Technology Integration (LoTi) questionnaire as a unique and notable instrument for the process of engaging in reflective practice concerning integration when compared to other survey instruments. Teachers viewing the results were jolted to the realization that integration, or a large portion of the process, was readily available to them due to their high comfort level with computer use. The gap between computer skill and integration skill is supported by literature cited in Chapter 2. The role of technology in professional learning is often characterized by low level cognitive engagement (CEO Forum, 2000; Doherty & Gabbard, 1998; Fisher, Dwyer & Yocum, 1996; Forcier, 1999; Jonassen, 2002; Kurubacak, 1998; McKenzie, 1999; Moersch, 2002; Sparks, 1998). Teachers are learning new technology skill sets, but failing to gain insight or expertise in the process of connecting technology and rich student learning.

Conclusions: Emerging Tools

Adult learners invested in designing relevant technology experiences for their classrooms are not necessarily comfortable using the emerging tools preferred by their students.

The research design for this study included the availability of online tools for participants' reflection and interaction. Specifically a content management system was established using Moodle to give participants access to blog and wiki resources. Despite repeated prompting, coaching and support from the researcher only one teacher participant contributed any substantive content to the web site. Her engagement can be explained, in part, by her comment that she was comfortable with blog sites because she uses them to get involved in some political discussions. The same participant shared that an electronic medium was already a very comfortable way for her to reflect. While talking about the online component of the study she mentioned, "I like to type. I like to reflect that way. It helps me".

Based on data gathered during informal interviews with participants an emerging technology that I would substitute for the online blog and wiki is the use of videoconferencing. Participants noted the natural evolution from email/chatting to blog/wiki and on to the virtual face-to-face environment of the videoconference experience. Findings of this study suggest the use of videoconferencing tools to generate new models of ongoing professional learning is an area the bears further investigation.

Conclusions: Digital Story

The opportunity to tell a personal tale of transformation leads to an increased focus on continual learning, improvement of practice, visionary thinking, and willingness to risk.

The research design included a digital story to assist with the reflective and narrative portion of the research. It was received by participants in a manner similar to the Moodle web site discussed in the previous section. The digital story, as intended by the researcher, never materialized during the six week period of the research study. The salient aspect of the digital story was the chance to share the transformation of belief, attitude, or practice that each participant experienced, or failed to experience, during the course of the study. This "telling my story" aspect was evident however in many of the verbal exchanges between participant and researcher, or among participants in a face-to-face setting. In this regard the literature reviewed in Chapter 2 proved to be a useful frame to create meaning of this apparent failure of the research design.

Given the opportunity to conduct this study again I would revise the notion of digital story to be less of a recursive tool for participants to model integration use while reflecting and more of an verbal and collaborative experience for reflection, goal-setting, and collaboration. Data gathered during

this study indicate that the power of the storytelling aspect is strong and that "telling the story using technology tools" is not a necessary component for participants to consider storytelling as meaningful in their growth as integrators. The key aspect is the level of thinking that was evident in the telling of their personal stories.

This phenomenon is consistent with research of Jonassen (2000) mentioned in Chapter 2. For the purpose of this study it is important to determine the role of mindtools, and reflection, in a collaborative setting for ongoing learning. In order to be considered a mindtool, the technology use must lead to higher levels of thinking by the participant. The types of thinking that qualify include: knowledge construction, reflective thinking, amplified thinking, reorganized thinking, and collaborative thinking (Brown & Duguid, 2000; Fisher, Dwyer & Yocum, 1996; Jonassen, 2000; Kurubacak, 1998; McKenzie, 1999; Robb, 2000). While the lack of digitally-edited video vignettes would prohibit the connection of technology as a mindtool, the type and depth of thinking that characterizes a mindtool use were present in the low-tech telling of stories in face-to-face sessions.

Implications

Findings of this particular study have implications for policy and practice of K-12 education systems. The researcher suggests five specific implications:

1) Create Communities
2) Create Opportunities
3) Create Tension
4) Create Stories
5) Create Questions.

Create Communities

The research of Brown & Duguid (2000), Lave & Wenger (1991), and Sparks & Hirsh (1997) all report findings that are consistent with results from this study concerning the importance of professional learning in the context of a collaborative group focused on the improvement of students' learning experiences and achievement.

The low engagement by participants with the online collaborative tools in this study intersects with the findings of The National Staff Development Council (NSDC), indicating that differentiating the delivery of ongoing learning is vital – even in our follow-up. Technology can help to facilitate

follow-up activities associated with staff development. It can assist the creation of ongoing learning that is personalized and unique instead of generic. (Sparks, 1998).

Differentiation is needed for our students and necessary to increase the efficacy of professional learning in our schools. I suggest that the use emerging tools may be most promising with teachers already comfortable with asynchronous blog and wiki environments. The growth of online graduate courses appears to contradict the experience of participants in this study, but the cultural context imposed by the K-12 system may be most influential in this dichotomy. Videoconferencing tools may hold the most promise for digital immigrants, but this certainly is an area where further research is needed to inform our professional practice.

Create Opportunities

Coaching opportunities during the study were mentioned by participants' as important events to influence their lesson planning, goal setting, and classroom practice. The researcher suggests that the one-to-one, or one-to-many coaching opportunity was not as significant as the minimizing of risk that the coaching experience represented. The experience of the coach supported innovation during goal setting and instructional planning, but the

high-quality planning would be compromised if the classroom context did not include the coach's support during initial attempts at implementing the lesson plan. Despite the impact of coaching observed during the study the researcher is not suggesting that organizations create more coaching opportunities per se. Rather the researcher suggests we build toward a culture of continuous coaching and shared professional practice.

Looking beyond the hiring of instructional coaches to the development of multiple opportunities for limited-risk instructional opportunities aligns with the findings of Lave & Wenger (1991) in regard to situated learning and legitimate peripheral participation. Co-teaching, classroom release time for peer observation and mentoring, job-sharing, or other ideas may be necessary to overcome the limitations of time, schedule and finances, but a focus on situated learning is a vital component if systemic improvement is going to be realized.

Systems thinking is a necessary component of any change effort – especially deep, cultural change (Fullan & Hargreaves, 1996; Sparks & Hirsh, 1997; Wheatley, 1994). Well intentioned attempts to provide quality professional learning can have limited impact on practice because they are designed and implemented with little regard to the nature of organizations and systems. We must shift our focus to the natural, embedded processes that

develop whole organizations – and implement learning models that recognize the importance of these processes.

The data most compelling in this area however are the data that are missing. No interactions with teacher participants pointed to existing models of integration, or availability to technology mentors. Forming a community of practice is best accomplished by experiencing gradual, authentic contributions to that community. In the case of technology integration it appears to be an all-or-nothing proposition. If teachers are not able to invest the time, energy, risk, and research needed to accomplish a complete integration design their other choice appears to be no integration at all. Perhaps the middle ground is where Mrs. Foster and Mrs. Keaggy have been experiencing the use of technology . These two participants often chose low-level use such as software for remediation only, or tools that facilitate multiple choice style reviews for summative assessments. This is a culturally acceptable option, and even garners accolades from administration and staff because technology is present in the classroom. If the use of technology is going to progress toward higher levels of the LoTi framework it will need to be assisted by a culture of common practice, and shared expertise. Knowledge required to accomplish this systemic shift is found in an organization, not in individuals. Data collected during this study represents a lack of community knowledge needed

to move integration practice ahead with any substantive gains. In short we must build authentic communities of practice within our organizations.

Create Tension

The researcher is not suggesting the creation of an atmosphere, climate or culture that places unhealthy expectations or environments upon administrators, teachers or students. The desired tension is a positive, cognitive, visionary tension that exists when one is keenly aware of their own practice, an authentic, systemic need, and how their improved practice could become a vital part of the creative, continuous improvement to address the systemic need.

When designing ongoing learning experiences for professional staff to begin or improve instructional practice related to the integration of technology include an inaugural event that will create a certain amount of tension concerning their view of their own current practice. This kind of experience was mentioned by teachers as a salient aspect of their research participation. This finding is aligned with research highlighted early by Maor (2000) who states that developing a constructivist approach to teaching and learning, "influences teachers' classroom practices and, subsequently, helps students to develop higher-order learning skills." (p.308). He believes that experiencing a

novel learning environment for their own study can assist teachers in reshaping their beliefs and instructional practices. The unique reporting structure of Levels Of Technology Integration (LoTi) questionnaire served to create a novel experience for professional learning. The one-on-one coaching and group dialog helped to create a positive tension between current practice and possible practice. This discussion helped create a tension for participants around the very notion of a professional learning community. Collegial and friendly groups are not the same as professional communities of practice.

Create Stories

Digital stories, as imagined by the researcher, did not emerge from this study but the power of storytelling did. This finding suggests that when a system creates opportunities for members to share their stories of instructional practice, beliefs, questions, and solutions they are creating an opportunity for powerful, transformational learning that can improve instructional practice in the classroom.

Implications include overcoming the often-held beliefs among researchers and practitioners that stories are unreliable evidence, or untrue. Attitudes demonstrated by comments such as as, the student "told me a story" about his late assignment or the report is merely a "bunch of stories" the

department created to support their position. It may be necessary to create specific protocols or prompts to both focus participants' energies toward stories that are characterized by in-depth reflection and a focus on improving practice to improve student achievement.

Create Questions

This research study has answered many aspects of the research questions it purposed to explore but new questions have also emerged. This is part of the natural cycle of research, especially qualitative research and it provides opportunities for the findings of this study to be extended.

Further study is warranted in several areas including: 1) the use of videoconferencing during professional learning as a way to overcome some of the time/travel constraints yet maintain the comfort level of face-to-face interaction for digital immigrants. 2) investigation of specific cultural and contextual beliefs that influence or limit the efficacy or professional learning in the K-12 public school setting. While the cultural context emerged as a key factor in this study further investigation is needed to more fully describe the phenomenon. 3) exploration of methods and contexts that facilitate the creating and sharing of stories. Professional stories of transformation occurred in unexpected ways during this study and questions about how storytelling

can best be cultivated and used as a new model of staff development merit continued research efforts.

Significance

This study is significant for several reasons. The research supports and extends various studies. Teacher participants learned to view the direct relationship between high-quality integration of technology and higher order thinking skills. The study indicates further research is needed to examine the relationship of emerging technologies and new models of professional learning. This study contributes to the expanding group of researchers looking at technology for learning using a qualitative design.

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Appendix A – Levels Of Technology Integration (LoTi)

Table 1: The Levels of Technology Implementation (LoTi) Framework

Level 0 - Nonuse
Technology-based tools (e.g., computers) are either (1) completely unavailable in the classroom, (2) not easily accessible by the classroom teacher, or (3) there is a lack of time to pursue electronic technology implementation. Existing technology is predominately text-based (e.g., ditto sheets, chalkboard, overhead projector).

Level 1 - Awareness
The use of technology-based tools is either (1) used almost exclusively by the classroom teacher for classroom and/or curriculum management tasks (e.g., taking attendance, using grade book programs, accessing email), (2) used to embellish or enhance teacher-directed lessons or lectures (e.g., multimedia presentations) and/or (3) is one step removed from the classroom teacher (e.g., integrated learning system labs, special computer lab pull-out programs, central word processing labs).

Level 2 - Exploration
Technology-based tools supplement the existing instructional program (e.g., tutorials, educational games, basic skill applications) or complement selected multimedia and/or web-based projects (e.g., internet-based research papers, informational multimedia presentations) at the knowledge/comprehension level. The electronic technology is employed either as extension activities, enrichment exercises, or technology-based tools and generally reinforces the content under investigation.

Level 3 - Infusion
Technology-based tools including spreadsheet and graphing packages; multimedia and desktop publishing applications; and the internet complement selected instructional events or multimedia/web-based projects at the analysis, synthesis, and evaluation levels. Though the learning activity may or may not be perceived as authentic by students, emphasis is placed on using a variety of thinking skill strategies (e.g., problem-solving, decision-making, experimentation, scientific inquiry) to address the content under investigation.

Level 4a - Integration (Mechanical)
Technology-based tools are integrated in a mechanical manner that places heavy reliance on prepackaged materials, outside resources, and/or interventions that aid the teacher in the daily management of their operational curriculum. Technology is perceived as a tool to identify and solve authentic problems as perceived by the students relating to an overall theme/concept. Emphasis is placed on student action and/or on issues resolution that requires higher levels of cognitive processing and in-depth examination of the content.

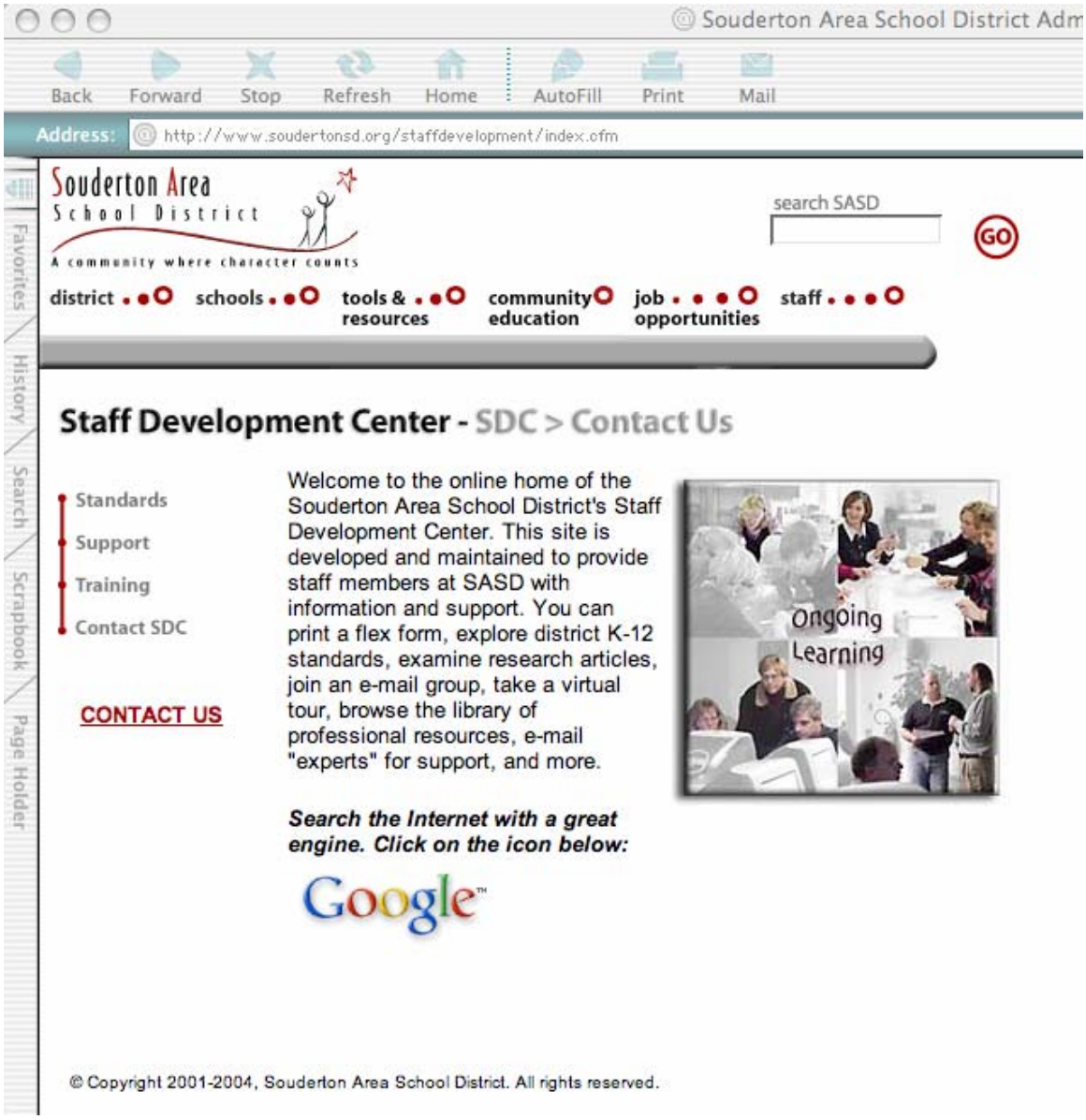
Level 4b - Integration (Routine)
Technology-based tools are integrated in a routine manner whereby teachers can readily design and implement learning experiences (e.g., units of instruction) that empower students to identify and solve authentic problems relating to an overall theme/concept using the school's available technology with little or no outside assistance. Emphasis is placed on student action and/or on issues resolution that requires higher levels of student cognitive processing and in-depth examination of the content.

Level 5 - Expansion
Technology access is extended beyond the classroom. Teachers actively elicit technology applications and networking from outside sources to expand student experiences directed at problem-solving, issues resolution, and student activism. The complexity and sophistication of the technology-based tools used are now commensurate with (1) the diversity, inventiveness, and spontaneity of the teacher's experiential-based approach and (2) the students' level of complex thinking and in-depth understanding of the content at hand.

Level 6 - Refinement
Technology is perceived as a process, product, and/or tool for students to find solutions related to an identified "real-world" problem or issue of significance to them. Technology provides a seamless medium for information queries, problem-solving, and/or product development. The classroom content emerges based on the needs of the learner according to his/her interests, needs, and/or aspirations and is supported by unlimited access to the most current computer applications and infrastructure available.

Appendix B – Oral History CD-ROM

Appendix C – SDC Web Site



Appendix D – Technology Integration Lesson Plan Format

Target Grade Level(s): x LoTi Level: x

Title Of Lesson

50-80 word overview of this lesson/project. 50-80 word overview of this lesson/project. 50-80 word overview of this lesson/project. 50-80 word overview of this lesson/project. 50-80 word overview of this lesson/project. 50-80 word overview of this lesson/project. 50-80 word overview of this lesson/project. 50-80 word overview of this lesson/project. 50-80 word overview of this lesson/project.

Project Description

3-4 paragraph overview with some general criteria for the lesson or project. See examples from the ALI site. 3-4 paragraph overview with some general criteria for the lesson or project. See examples from the ALI site.

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Learning Goals

After completing this project, students will be able to:

- 3-6 outcomes of their learning connected to curriculum
- 3-6 outcomes of their learning connected to curriculum
- 3-6 outcomes of their learning connected to curriculum

Technology Skills

After completing this project, students will be able to:

- 3-6 outcomes of their learning connected to tech skills spiral

- 3-6 outcomes of their learning connected to tech skills spiral
- 3-6 outcomes of their learning connected to tech skills spiral

Assessment Suggestions

A place to point to rubrics or criteria developed to describe quality student performance.

Internet Resources

Web sites with examples or resources listed here

- www.???.???
- www.???.???
- www.???.???

Tools

Hardware, software & peripherals needed for the lesson/project or performance task.

Teaching Tips

Share your insights here about making this lesson as meaningful for students as possible!

Appendix E – Technology Integration Mini Lesson

Integration Mini-lesson
Grade: K **LoTi Level:** 3 **Title**: Basic Operations/Social, Ethical & Human Issues
PA Standards: **NETSS Standards:** 1, 2

Instructional Periods: 1

21st Century Skill or Concept (brief description):
Description here…

How will the skill/concept be demonstrated? (brief description of task/product):
Description here…

Performance or Product Rubric:
See attached sheet…

Materials (hardware/software/peripheral) & Location (lab/classroom/either):
List instructional materials here…

Appendix F – Interview Protocol

A Teaching -Learning INTERVIEW for teachers and their students

Teacher	Notes	Student	Notes
• What are your students' **learning needs?** • What are the learning **goals** for students in terms of **essential concepts or skills?** • What questions, problems, experiences or projects will students complete or answer?		• What are you working on or what have you completed? • What **problems** did you encounter & how did you solve them? • What did you find most **interesting**? • What **skills** are you learning? ? What are the main ideas/**concepts**?	
Relevance		**Relevance**	
• How are you making this **relevant** to students' lives? Which NETSS **standards** or LoTi level is addressed in this unit? (workplace applications, future studies)		• **Why** are you learning this? • Of what r**elevance** is this to future applications? • What are the **standards** targeted in this work?	
Assessment		**Self-Assessment**	
• How will you **assess** the learning? • Do you share **criteria** with students? Do you have **exemplars**? • How and when do you give students **feedback** on their learning (formative)?		• What **criteria** do you use to assess your work? Do you have **models** or examples to guide you? • Of what **quality** is your work ? How would you **improve** it?	

Additional Questions

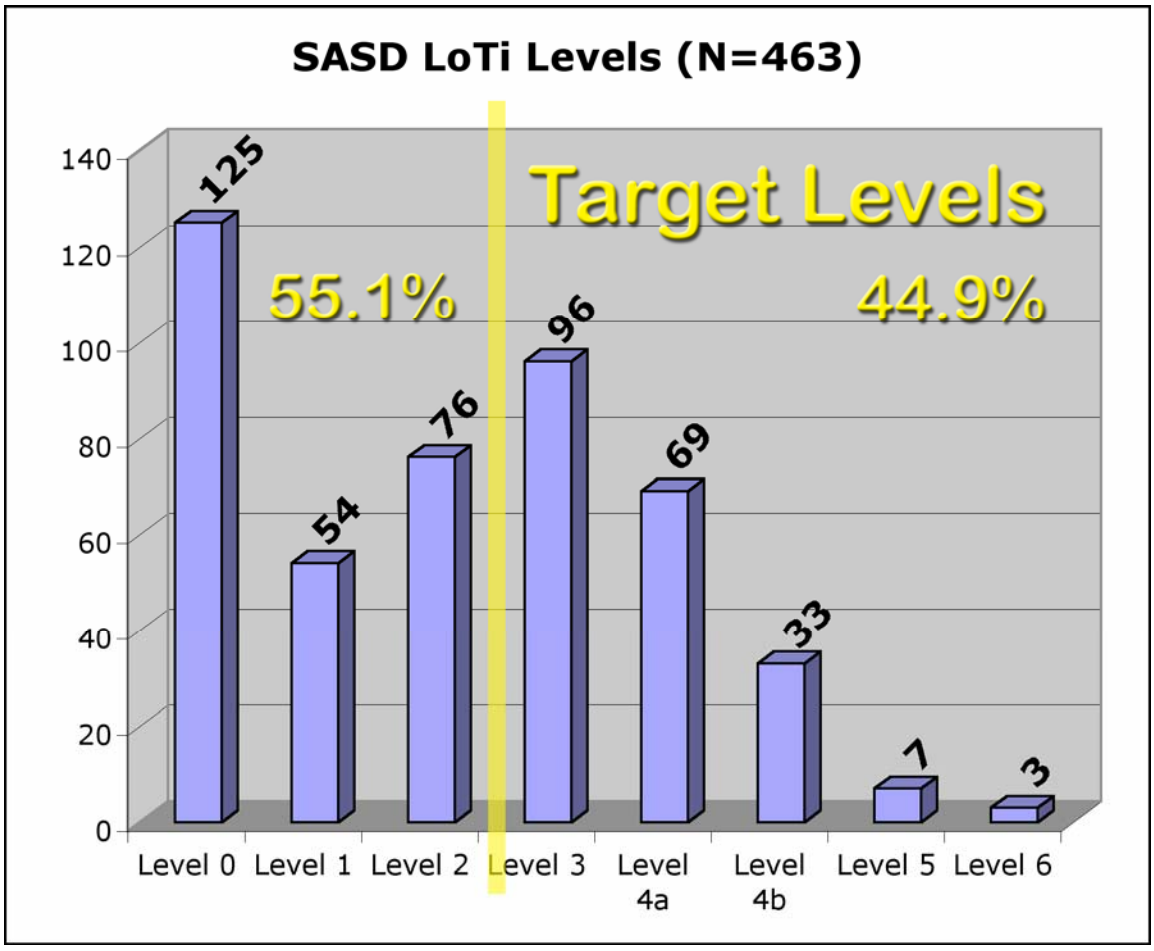
Reflections on this Interview (Are there any components missing? What revisions are needed?)

Teacher/Student Interview Protocol, 2001, © Dr. Marion Dugan

Appendix G – LoTi Observation Log

LoTi Level / Criteria	Observation	Reflection / Evidence
0 1 2 3 4a 4b 5 6 no visible evidence teacher productivity focus on content tool-based applications outside resources authentic problems tech from outside entities seamless & transparent		
0 1 2 3 4a 4b 5 6 no visible evidence teacher productivity focus on content tool-based applications outside resources authentic problems tech from outside entities seamless & transparent		
0 1 2 3 4a 4b 5 6 no visible evidence teacher productivity focus on content tool-based applications outside resources authentic problems tech from outside entities seamless & transparent		

Appendix H – Taylor Area School District LoTi Data



Vita

David Edward Ramage has been helping inservice and preservice teachers explore the integration of technology since 1987 when he led sessions with a MIDI sequencer and a Macintosh computer for music educators. His professional passion is to decrease the distance between the way students use technology in their lives, and the way they use technology at school.

Lebanon Valley College - B.S. Music Education, 1982

DeSales University - M.Ed. Computers in Education, 1998

Drexel University – Ph.D. Educational Leadership Development and Learning Technologies, 2007 (expected completion)

Souderton Area School District, Coordinator of Technology Staff Development: design and implement the districts' integration of technology.

California University of Pennsylvania, Adjunct Instructor: MSE740 Advanced Instructional Strategies, a fully online course.

Drexel University, Adjunct Instructor: EDUC510 Computer Applications; EDUC511 Classroom Technology Integration; assorted workshops.

DeSales University, Adjunct Instructor: CE550 Multimedia Classroom Applications

Reviewer: National Staff Development Council 2005; National Educational Computing Conference 2006, 2007, & chair for handheld computing, 2007.

Presenter - Penna. Educational Technology Conference & Expo, 2006; 2007

Leading & Learning Magazine - Technology Leader of the Year 2005, finalist

Palm, Inc. - Palm Educational Trainer Coordinator (PETC), 2003

Tech2Go - podcast and blog site. http://tech2go.edublogs.org