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Factors affecting teachers' level of technology implementation in a Texas private school

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FACTORS AFFECTING TEACHERS' LEVEL OF TECHNOLOGY IMPLEMENTATION IN A TEXAS PRIVATE SCHOOL

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by

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DEDICATION

The journey has been long and winding and it could not have happened without the love, support, and prayers of my family and the guidance and strength of God through Jesus Christ. To my wife, Karen, I could not ask for a better wife, partner, and best friend. It has been your encouragement, your support, your prayers, your tireless editing and proofing, and sometimes your insistence, that has continued to keep me on the journey. You probably know my paper better than I do. To my boys, Nat and Drew, I appreciate your understanding of the times that I needed to work and for the constant support, prayers, pushing, and encouragement that I needed to work and finish. Can we now change from DrDad to Dr. Dad?

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Northland Christian School, Houston, TX — 2003-2009
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ABSTRACT

The purpose of this study was to discover if there was a relationship between the levels of technology implementation and teachers' instructional practices, personal computer use skills, and experiences in a Texas Private School. The LoTi Digital Age Survey was used to assess the current beliefs of the teachers along with additional questions regarding age, subject, experience, and years that the teacher has participated in the school's current professional development program.

The results of this study did not find any statistical relationships with any of the variables. However, the study did show that the teachers have made progress in using technology for higher-order tasks, but with the exception of three math, science, and technology teachers they have not reached a level that uses technology with student-centered instruction. This could be a statistical error due to the small sample size, it could indicate that pedagogy is not a relevant factor and teachers will continue to use mixed methods (Levin & Wadmany, 2006), or the self-efficacy of the teachers is such that they need specific modeling to integrate technology at a higher level (Moersch & Ondracek, 2005)

Chapter 1: Overview of the Problem

Call to Change

The call to change our classrooms and prepare students for the 21^{st} century using technology is a message that schools are receiving from many different sources. In The National Education Technology Plan 2004 the U.S. Government encourages schools to create "ubiquitous access to computers and connectivity for each student." (p. 43). The CEO Forum recommends that new assessment strategies be developed and that schools create equitable access to technology (CEO Report, 2001). Students also recommend ubiquitous access. In the "Visions 2020 report" students stated that every student should have access to a computer twenty-four hours a day, seven days a week (U.S. Department of Education, 2004). Other organizations have been calling for a change in what students learn and the need for students to develop 21st century skills. These skills include using digital tools for problem solving, communication, collaboration, creativity, and researching (EnGauge, 2000; NETS For Students 2007 Standards, 2007).

A common response from schools has been to increase student access to technology and make technology a major component of learning activities. It is estimated that thousands of private and parochial schools, and as many as 14,000 public school districts, have already created a ubiquitous environment by implementing one-to-one programs (Livingston, 2006). But the goal of school reform is not simply the addition of technology. Integrating technology is a key element in school reform to ultimately improve teaching and learning (*National Education Technology Plan 2004,* 2004; Johnston & Barker, 2002).

How do schools assess whether the implementation of technology is improving teaching and learning? The answer is not consistent for every program. Schools have different goals and unique situations with different variables. Johnston and Barker (2002) have identified differences that include vocabulary use, testing measurements, short term outcomes vs. long term outcomes, and teachers' technology skills vs. changing practices. Penuel (2006) has identified four different reasons why schools create one-to-one programs, which make differing assessment strategies apparent:

1. Improving academic achievement.
2. Increased equity of access to technology and resources.
3. Preparing students for a "technology-saturated workplace".
4. Improving the quality of instruction by becoming student-centered.

One method for determining the effectiveness of technology in the classroom is to evaluate how teachers are integrating technology into their lessons. Teachers control how technology is used or as Cuban (2001) states they are the "gate-keepers". How a teacher uses technology in the classroom can change the way students think and learn (The CEO Forum, 2001). Becker (2000) defines exemplary computer-using teachers as teachers who create activities that engage their students in using computers for higher-order thinking.

Research has shown that when teachers have students use technology for tasks that require higher-cognitive processing, student achievement increases (Schacter, 1999). According to the National Assessment of Educational Progress (NAEP) study (Moersch, 1999), eighth grade students whose teachers used computers primarily for higher order thinking performed better on NAEP than students whose teachers did not. "Conversely, eighth grade students whose teachers used computers primarily for 'drill and practice'-

generally associated with lower order thinking skills - performed worse" (Learning Quest, Inc., 2002, p.6). A study conducted by the Educational Testing Service found that when teachers were trained to use technology and students used technology for higher-order thinking in mathematics that the students gained one-third grade level (The CEO Forum, 2001). Middleton (1998, cited in Schechter, 2000; 1998, cited in Moersch, 2001) found that students performed better on the Metropolitan Achievement test when their teachers used technology for higher-level learning. Wenglinksy (2004) found that student achievement is increased when teachers used approaches that taught for meaning, such as having students interpret what they read through writing and reflection, or interacting with government officials concerning policies.

Factors related to change. Research has shown that the change that teachers must make to integrate technology takes time and is a process (Moersch, 2002; Sandholz, Ringstaff, & Dwyer, 1997). As schools continue to integrate technology it is important that leadership understands the factors relating to teachers positively progressing in the technology implementation process and the barriers to that progress. Ertmer (1999) describes barriers to technology implementation as first and second-order barriers.

First-order barriers are typically ones that are often external to the control of the teachers such as access, training, and support (Ertmer, 1999). Do they have enough computers? Do they know how to use them? Who will fix them if they break? Second-order barriers are ones that are more personal for the teacher and are ones that "interfere with or impede fundamental change" (Brickner, 1995 as cited in Ertmer 1999), such as a teacher's instructional belief system (Ertmer, 1999, 2005) and their self-efficacy (Ertmer & Ottenbreit-Leftwich, 2010; Moersch, 1995).

Access to technology is clearly an important variable for integration into the classroom, but it doesn't seem to be the fundamental factor for teachers. Becker and Ravitz (2001) found that teachers with 5 to 8 computers in their room were more likely to use computers than those who went to a lab. When the ratio is one-to-one, Penuel (2006) discovered that computers are used more often and across the curriculum. Access seems to be an important variable in terms of use, but studies have shown that access is not an indicator that computers will be used for higher-level tasks (Cuban, 2001; Moersch, 2001, 2002).

Since the original work, Ertmer (2005) has added that second-order barriers, or teacher instructional beliefs, need to be viewed in terms of experiences. These experiences include personal experiences, vicarious experiences, and social-cultural influences. This would include factors such as experience using technology, the influence of a peer or mentor, and the effects of "influential others" (Ertmer, 2005).

Theoretical Framework for Change

For schools to integrate technology for high-order uses, leaders need to understand how to help teachers successfully learn to integrate technology and to be able to assess their progress. Moersch (1995) saw self-efficacy as a fundamental reason why teachers did or did not progress through stages of change. Ertmer and Ottenbreit-Leftwich (2010) also concluded that self-efficacy was an important barrier that needed to be overcome for teachers to integrate technology. Self-efficacy suggests that people have a need to control what they do, so they will only take actions based on what they believe they can accomplish or control, not on what is actually true (Bandura, 1997). Individuals do not have an incentive to act if they don't believe that their actions can produce the desired effect (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996). Without these beliefs then individuals are less motivated, less able to handle adversity and are not as committed to goals (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996). When involved in innovations, individuals with low levels of self-efficacy may not choose the best option, but instead will choose the level that they feel they can control. Individuals with high levels of self-efficacy are more likely to accept change and will choose innovations that are the best (Moersch, 1995).

Based on the current literature, three factors that I believe affect a teacher's self-efficacy include: computer use knowledge (Inan & Lowther, 2010), instructional practice beliefs (Overbaugh & Lu, 2008), and experiences (Mueller et al., 2008). Teachers need training and experiences to develop the personal computer knowledge to understand how to use technology for student learning (Inan & Lowther, 2010; Moersch, 1995), an instructional practice belief to promote using technology for higher-order uses in a student-centered learning environment (Ertmer & Ottenbreit-Leftwich, 2010; Moersch, 1995), and the experiences to believe that they can implement these tools in a way that will meet their learning goals (Moersch, 1995; Mueller et al., 2008). By helping teachers with their computer skills, instructional practices, and experiences, teachers will increase their self-efficacy beliefs that will allow them to progress through the stages of integrating technology for higher-level uses.

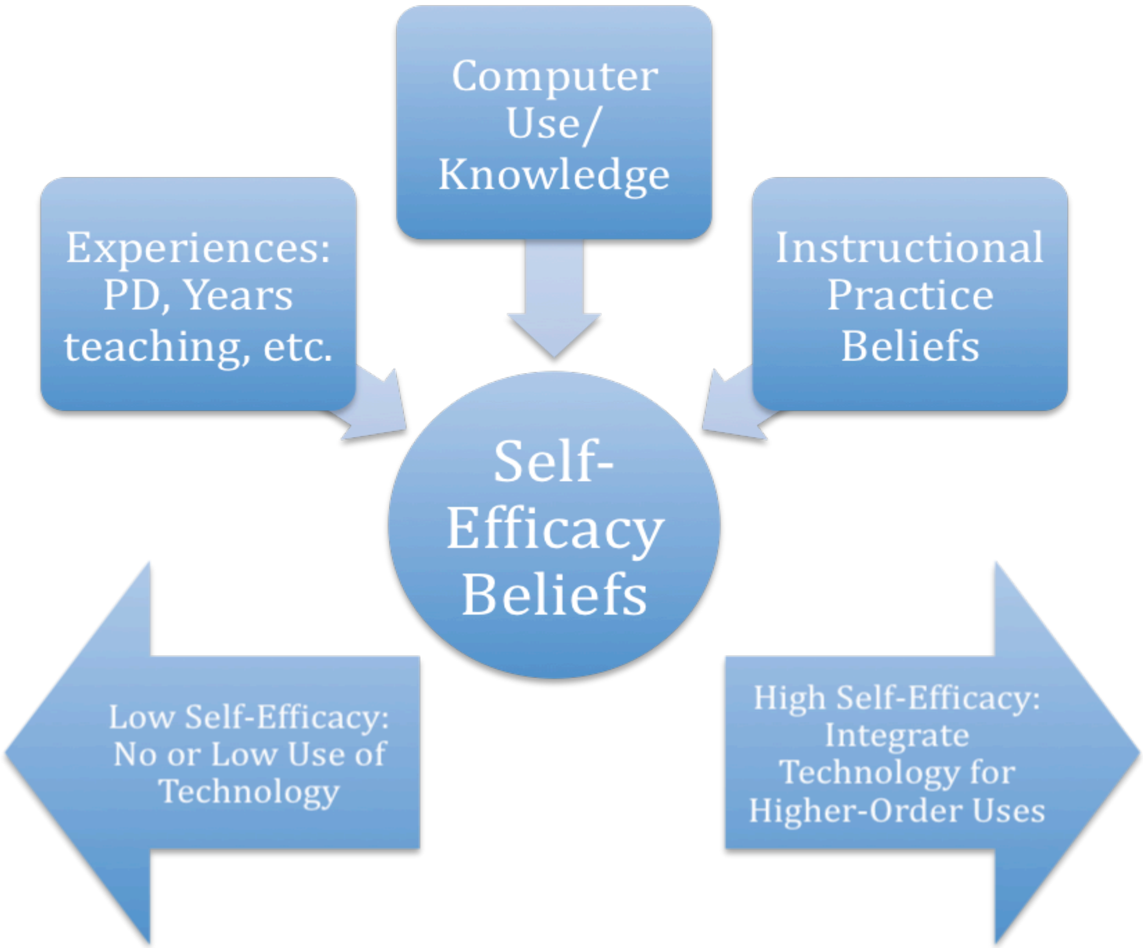

Figure 1. Self-efficacy chart

Computer use knowledge. Computer proficiency has been shown to help teachers progress through the stages of implementation. Studies indicate that the more comfortable, or proficient, a teacher is in using computers for classroom use the more they will progress in the stages of implementing technology for higher level uses (McAdoo, 2005; Schechter, 2000). Becker and Ravitz (2001) identified computer knowledge as a factor increasing the likelihood that teachers will give assignments using computers. Mueller et al. (2008) found that computer use was one difference between high integrating teachers and low integrating teachers. Inan and Lowther (2010) found computer proficiency to be one of the most important factors affecting the technology integration of a teacher.

Instructional practice. There also seems to be a positive relationship between the level that a teacher implements technology and the teacher's belief in student-centered instructional practices (McAdoo, 2005; Schechter, 2000). Rakes, Fields, and Cox (2006) also found that there was a stronger relationship of how a teacher implemented technology and their student-centered instructional practice when combined with the increase of the teacher's computer use skills. Fairman (2004) found that in the Maine program the introduction of laptops may have caused teachers to create a more reciprocal relationship with the students and that they moved to having a more student-centered approach. Sargent (2003) found that with the introduction of laptops, the majority of teachers were using less direct-instruction.

One student-centered method for increasing the use of technology for higher-order thinking is in the use of constructivist teaching methods. Constructivism is a learning theory where individuals construct, or make meaning, when they build their current knowledge with new ideas (Richardson, 2003). According to Ravitz, Becker, and Wong (2000), a constructivist learning environment tends to involve activities of the following five types: projects that employ a variety of skills and diverse tasks, group work, problem-solving that requires thinking and planning, reflective thought through writing, and other tasks that require meaningful thinking.

A constructivist environment does not require technology and technology use does not require constructivist methods, but when the goal is to develop more than simple knowledge the two seem to complement. In the ACOT program, Sandholtz et al. (1997)

found that when technology was combined with constructivist teaching methods, such as problem solving and critical thinking, instead of simple acquiring of facts, technology was being used in the most powerful way. Moersch (1998) stated that teachers who create this kind of environment can create classrooms that move students to authentic action in an experiential learning environment. When the goal is to develop higher-order thinking skills, problem-solving skills, visual presentation skills, use alternative forms of assessment, or to involve the student in their performance evaluations, the constructivist models, or student-centered models, are more likely to use technology and align better with those goals (Johnston & Barker, 2002).

Experiences. The confidence level of the teacher can play a significant role in how, or if, technology will be integrated into a teacher's classroom. In some cases, teachers who have integrated technology at high levels reported that they had higher levels of confidence in integrating technology into their classes than they had in their actual computer skills (Ertmer & Ottenbreit-Leftwich, 2010; Wozney, Venkatesh, & Abrami, 2006). Other factors that have shown to impact self-efficacy, either positively or negatively, include experience using technology (Mueller et al., 2008), professional development (Overbaugh & Lu, 2008), gender (Mueller et al., 2008), and years of experience (Inan & Lowther, 2010; Mueller et al., 2008). Professional development has been shown to increase a teacher's computer self-efficacy and computer skills given enough time (Brinherhoff, 2006).

Conceptual framework for assessing technology implementation. The beliefs and practices of teachers seem to run on a continuum that reflects how teachers change from teacher-centered on one end to student-centered on the other (Levin & Wadmany, 2006; Moersch, 1995; Sandholtz, 1997). Teachers seem to respond differently to innovations and hold multiple views that affect their change (Levin & Wadmany, 2006). One framework for measuring this change in technology implementation is the Level of Technology Implementation (LoTi) framework developed by Dr. Chris Moersch (Moersch, 1995, 2002).

The LoTi framework proposes eight different levels of change from 0 (non-use) to 6 (refinement) that teachers progress through as they implement technology for higher-level uses in the classroom. As a teacher progresses through each stage a series of changes occur in the instructional practices, the uses of technology, and the assessment practices. Instructional practices using technology change from being teacher-centered to more student-centered or constructivist, technology tools are used for tasks that require higher cognitive processing and finding solutions to authentic problems, and assessment strategies are varied (Moersch, 1995, 2002). Moersch (1995) created the framework after observing that many technology innovation programs failed because leaders did not take into account the issues involved with teachers making a change.

In addition to the LoTi framework, Moersch (1995) also developed the Current Instructional Practice Framework (CIP) and the Personal Computer Use Framework (PCU). The Current Instructional Practice Framework (CIP) identifies the general instructional practice, or pedagogical beliefs, of a teacher ranging from an exclusively subject-matter, lecture based, approach to an exclusively student-centered, or constructivist, approach. The Personal Computer Use Framework (PCU) identifies the fluency level, or computer knowledge, of a teacher in using digital tools in the classroom.

Problem Statement

It is important that school leaders understand the factors that affect how teachers progress in implementing technology, so that technology can be used in a manner that positively affects the academic achievement of the students. For many schools access is no longer a barrier, because every student has their own laptop computer or mobile device. But, access does not ensure higher-level uses. There are many other factors that can be explored, but understanding the factors related to the teacher's self-efficacy beliefs is central to any implementation.

For many teachers, there clearly seems to be a connection between technology uses and constructivist models, but it is not the case in all situations. In many classrooms technology is only being used for lower-level skills, instead of for higher order uses. Out of 24,000 teachers surveyed from 1999-2001, Moersch (2001) found that 69% of teachers were using technology for lower level skill development, which is Level 2 and below on the Level of Technology Implementation (LoTi) scale. In 2002-2003 the study was performed again with 32,540 teachers and 64% were found to be using technology only for lower-level tasks (Learning Quest, Inc., 2004) This result is supported by other studies that have found that technology-rich classrooms do not automatically imply a more student-centered learning environment (Cuban, 2001; Palak, 2004). In some schools, teachers had general beliefs associated with a student-centered, or constructivist, model, but technology was only being used for low-level tasks (Cuban, 2001; Moersch & Ondracek, 2005; Underwood, 2007). Mueller et al. (2008) found that there was not a difference in constructivist beliefs between the teachers that showed high integration and those that showed low integration.

It seems that in some cases the instructional practice of the teachers do not always match how they are implementing technology into the classroom (Chen, 2008). They express certain pedagogical, or instructional, beliefs, but they use different instructional practices when using technology. This has caused Cuban (2006) to declare that pedagogy is not a factor and that teachers will continue to use both teacher-centered and student-centered instructional practices.

The relationship between the level a teacher implements technology in the classroom and the teacher's belief in a constructivist model still seems to be uncertain. It makes sense that as a teacher progresses through a scale that increasingly shows that they are using technology for student-centered activities that they also would show a progression in constructivist beliefs or practices, but perhaps the opposite is not true. Perhaps a teacher's belief in a constructivist model does not mean that they have the self-efficacy to implement these types of lessons with technology. Perhaps they lack the computer skills or confidence necessary to implement the technology that also complements their instructional practices. It may be that a teacher has high technology use skills, but lacks specific skills related to implementing technology for higher-order uses in their specific subject and needs specific training and modeling.

If having a more student-centered instructional practice relates to the level of implementing technology, then one method of increasing the progression of technology implementation for a teacher, would be to focus on training and activities that have shown to increase beliefs in constructivist methods. However, if having a student-centered instructional practice does not relate to the level of technology implementation, then it would explain why some teachers with beliefs in using constructivist methods only use technology for low-level tasks. It could be that there are specific computer skills necessary to successfully integrate technology for specific subjects (Hughes, 2005) or that correspond with specific instructional practices.

Purpose of the Study

Much of the research on technology implementation and how teachers change was performed at the end of the twentieth century and the beginning of the twenty-first century. Since then the world has continued to evolve at a rapid pace. Technology access, technology tools, and teacher training have changed in schools. Nationally, *The No Child Left Behind Act* and the *National Technology Plan 2004* have put a greater emphasis on using technology in the classroom. In Texas, the *Long-range Plan for Technology, 1996-2010*, which was updated and became the *Long-range Plan for Technology, 2006-2020*, and the *TeXeS* examination to certify teachers in Texas, are initiatives that have had an impact on teachers and technology (Learning Connection, Inc., 2006) implementation in schools.

In addition to changes in schools, the Internet continues to grow, the penetration of technology in homes is increasing and a new generation that grew up with technology and the Internet is graduating from college and becoming teachers. As the environments and programs change, it is important to continue to study, and add to the current knowledge base, how teachers are implementing technology and to discover the factors that affect change in teachers' use of technology for higher-level uses.

By continuing to discover more about a teacher's self-efficacy beliefs, and the impact of computer use skills, instructional practices, and experiences on the level of technology implementation, schools will have a better understanding of how to guide their teachers in moving through the stages of implementation to increase the effectiveness of programs. The purpose of this study was to determine if the instructional practices, personal computer use skills, and the experiences of teachers are significant factors in the level of technology implementation of teachers in a private secondary school in Texas.

Research Questions

1. Is there a relationship between the teacher's Level of Technology Implementation (LoTi) and Current Instructional Practice (CIP)?
2. Is there a relationship between the teacher's Level of Technology Implementation (LoTi) and the Level of Personal Computer Use (PCU)?
3. Is there a relationship between the teacher's Level of Technology Implementation (LoTi) and both the Current Instructional Practice (CIP) score and the Personal Computer Use (PCU) score?
4. Is there a relationship between the teacher's Level of Technology Implementation and the following demographics:
    - Overall Teaching Experience
    - Years of participation in the school's professional development program for creating a 21st century school
    - Age
    - Subject taught

Limitations

This study was not random and was conducted with the faculty of a single school. The entire population was invited and the sample was made up of the faculty members who volunteered. Results should not be generalized to other populations. Bias may have occurred in the results of this study because it was based on teachers' self-perceptions, not on direct observations.

Significance of the Study

The significance of this study is that it adds to the literature concerning factors that relate to a teacher's level of technology implementation and it provided data for the leaders in the private secondary school in Texas to use in making decisions to increase the effectiveness of the technology program. The sample was small, so the results should not be generalized outside of the population of the school where the study occurred, but it may reveal enough information concerning how instructional practices and personal computer use skills relate to the levels of technology implementation to encourage additional studies.

Definition of Terms

The following terms are important for this study and are defined to help the reader understand how the terms are used in the context of this study.

Teacher-centered instruction. Cuban (2006) describes teacher-centered instruction as a practice where "teachers control what is taught, when, and under what conditions." This model is also referred to as the "traditional learning environment" or a subject-matter approach.

Student-centered instruction. This practice typically allows students to learn at their own pace and "learn skills such as problem-solving, critical thinking, and reflective thinking" (National Center for Research, 1999, para. 1). Other names or models that are often considered student-centered are "learner-centered" (Moersch, 1995, p.41) and "constructivist" (Kelly & McAnear, 2002, p. 371).

Constructivist teaching. Constructivist Teaching is a theory and teaching strategy holding that learners actively acquire or "construct" new knowledge by relating new information to prior experience. It contrasts with strategies that rely primarily on passive reception of teacher-presented information. (Kelly & McAnear, 2002, p. 364).

One-to-one computing or ubiquitous computing. An environment where students are provided with portable laptop computers, have wireless access to the internet, and focus on using the laptops to complete academic tasks (Penuel, 2006, p. 331).

Personal Computer Use skills (PCU). A measurement of a teacher's fluency with using digital tools for student learning (Personal Computer Use (PCU) Framework, 2008)

Current Instructional Practices (CIP). A measurement of a teacher's instructional practice as it relates to a subject-matter vs. learner-centered approach. As a teacher progresses up the levels of the CIP scale, the indication is that they are practicing a more learner-centered approach to instruction. A teacher's CIP is independent of how they implement technology (Current Instructional Practices (CIP) Framework, 2008)

Levels of Technology Implementation (LoTi). A conceptual model to measure a teacher's implementation of classroom technology for authentic uses (LoTi Digital Age Framework, 2008)

Chapter 2: Review of Literature

Schools are continuing to be called upon to reform with the use of technology. Increased access to technology does not insure improvement in student learning, but student achievement increases when technology is used for higher-level uses. Teachers remain the key to creating change in the classroom and the teachers' self-efficacy to use technology to achieve their learning goals is critical. The factors such as instructional beliefs, computer skills, and experiences that affect a teacher's self-efficacy and how that impacts change need to continue to be studied.

The Addition of Technology in Schools

Schools being called to change. A call for change has been a constant since our nation moved from an industrial nation to an informational society. The need to keep pace with a global economy and the growth of many other nations has kept us in a continued search for answers. Our recent cry for change goes back to 1983 in *A Nation At Risk*:

> The people of the United States need to know that individuals in our society who do not possess the levels of skill, literacy and training essential to this new era will be effectively disenfranchised, not simply from the material rewards that accompany competent performance, but also from the chance to participate fully in our national life. (A Nation At Risk, 1983, ¶ 8)

Since the wake-up call in 1983, technology has played a major role in our societal changes and in the changes that we have attempted to make in education. These changes caused the call to continue in 1994 with the *Goals 2000 Education America Act* and in 1996 when President Clinton set forth his *Technology Literacy Challenge*. In President

Clinton's challenge, technology was given a prominent place in our change efforts with his four pillars:

- Provide all teachers the training and support they need to help students learn through computers and the information superhighway;
- Develop effective and engaging software and on-line learning resources as an integral part of the school curriculum;
- Provide access to modern computers for all teachers and students;
- Connect every school and classroom in America to the information superhighway. (Clinton, 1996, ¶ 8)

The call for change continued under the George W. Bush era with the *No Child Left Behind Act of 2001* and the *National Education Technology Plan 2004*. In the *National Education Technology Plan 2004*, the U.S. Department of Education recommended seven action steps in the area of integrating technology (National Education Technology Plan 2004, 2004):

1. Strengthen Leadership
2. Consider Innovative Budgeting
3. Improve Teacher Training
4. Support E-Learning and Virtual Schools
5. Encourage Broadband Access
6. Move Toward Digital Content
7. Integrate Data Systems (pp. 39-44)

The plan calls for schools to prepare today's students for a technologically-driven economy by developing new models of education that are technologically driven. In his challenge to the nation, President Bush stated:

> We cannot assume that our schools will naturally drift toward using technology effectively. We must commit ourselves to staying the course and making the changes necessary to reach our goals of educating every child. These are ambitious goals, but they are goals worthy of a great nation such as ours. Together, we can use technology to ensure that no child is left behind. (National Education Technology Plan 2004, 2004, p. 37)

The "Visions 2020.2" report (U.S. Department of Education, 2004) tells us that students see more technology and the ability to connect with others as central to transforming schools. In relation to access the students who participated in the 2004 survey wanted to see these six items created:

1. A computer for every student.
2. Faster modems and computers.
3. Wireless access to the Internet and networks.
4. Safer and easier technology.
5. Access twenty-four hours a day, seven days a week.
6. The ability to connect and collaborate with peers and teachers. (U.S. Department of Education, 2004, pp. 14-15)

Increased access. As we have moved into the 21st century, a new era of integrating technology into schools has begun as schools respond to the call to change by increasing access. Many schools are now embracing the concept of ubiquitous computing, or one-to-one mobile learning programs, and attempting to overcome the barriers of access that have been encountered in the past with integrating technology.

Many of the one-to-one programs today have multiple goals. States like Maine and Michigan initially started their programs to ensure the future economy of their states by trying to produce graduates who would be employable by high tech companies and who would succeed in a new economy. At the same time, they hoped that their programs would benefit students in all academic areas, not just in technology skills. (Livingston, 2006). In reviewing many of the studies performed on the latest one-to-one programs, Penuel (2006) and his team concluded that schools choose one or more of four basic goals when implementing a one-to-one program (Penuel, 2006):

1. Improving academic achievement.
2. Increased equity of access to technology and resources.
3. Preparing students for a "technology-saturated workplace".
4. Improving the quality of instruction by becoming student-centered.

Impact of Technology on Learning

The large investment in technology requires that schools evaluate the effectiveness of programs to determine if they are achieving their goals and making a difference in the classroom. However, deciding how a program is evaluated must be determined by the goals of the program and can differ from school to school based on policies and how technology is being used in the classrooms. There is not a single answer to implementing and evaluating technology programs, but research can give us a glimpse of how different programs are impacting the classroom.

Writing and math seem to be two areas where schools are showing gains in test scores. Schools involved in the Apple one-to-one program, such as Pleasanton Unified School District in California and the Peace River North School District in Canada, both have shown higher test scores in writing. The Pleasanton District also showed gains in mathematics (Gulek & Demirtas, 2005; Metiri, 2006; Penuel 2006).

The state of Maine in its statewide deployment established nine middle schools as exploratory Apple one-to-one programs. After two years of the program, those schools showed significant improvement on achievement test scores in science, math, and social studies. These schools scored much higher than their counterpart schools, which only had been in the program for one year (Metiri, 2006).

Other schools showing improvement on achievement test scores include Henrico County in Virginia and Irving Elementary School in Pennsylvania. After the first two years of the program, high school students in Henrico County showed increases on the Virginia Standards of Learning test in all eleven areas tested (Livingston, 2006). The Irving Elementary school, after implementing their program, received the Pennsylvania Governor's School of Excellence award for the improvement that they made on their test scores (Metiri, 2006)

> Use of the laptops to enhance writing skills for kids has been a great asset for me. Student ability to draft, revise, and edit written work has been greatly expanded with this program. Students can now also access information for use in written work much more easily than before. (Teacher Survey, 2003, reported in Silvernail & Lane, 2004, p.19)

Considering the cost of technology, an important question to ask is if a one-to-one computer to student ratio is necessary. Results from a meta-analysis (Penuel, 2006) suggest that one-to-one has three advantages over other ratios:

1. Computers are used more across the curriculum.
2. Less large group instruction is being reported.
3. Computers are used more often and for a wider variety of purposes.

Technology can make a positive impact on student achievement, but it may be difficult for schools to replicate programs implemented in other schools if the environments are not the same. One method of using technology that is not specific to a program or environment is the use of technology for tasks that require higher-order thinking. Research has shown that when teachers require students to use technology for tasks that require higher-cognitive processing, student achievement increases (Schacter, 1999).

Wenglinsky (2006) has been conducting research on the impact of technology on learning since the 1990s and he has found that results often depend on how technology is used. Wenglinksy (2004) found that student achievement is increased when teachers used approaches that taught for meaning. A National Assessment of Educational Progress (NAEP) study of fourth and eighth grade students in reading and mathematics found that students who used computers primarily for higher-order thinking showed greater benefits. Eighth-grade students who used technology to perform simulations and used software that required higher-order thinking in mathematics showed gains in math scores of up to 15 weeks above grade level (Wenglinsky, 1998). Wenglinsky (1998) also found that students who used computers for drill and practice, which only required low-level thinking, performed worse on the NAEP than students who did not use computers. A study conducted by the Educational Testing Service found that when teachers were trained to use technology, and students used technology for higher-order thinking in mathematics, that the students gained one-third grade level (The CEO Forum, 2001). Middleton (1998, cited in Schechter, 2000; 1998, cited in Moersch, 2001) found that students performed better on the Metropolitan Achievement Test when their teachers used technology for higher-level learning.

Creating Change

One approach to implementing a technology program that develops higher-order skills and improves student achievement, is for teachers to develop constructivist methods that are supported by technology.

Constructivism. Constructivism is a learning theory that is associated with student-centered practices. Constructivists would suggest that knowledge is not something that is just transferred, but learning is personal and individuals construct knowledge, or make meaning, by integrating old and new ideas, experiences, and points of view (Richardson, 2003; Sandholtz et al., 1997). In a constructivist, or student-centered classroom, teachers act as facilitators, there is less didactic teaching, and more collaboration is evident (Sandholtz et al., 1997). According to Ravitz et al. (2000), a constructivist learning environment tends to involve activities of the following five types:

- Projects that employ a variety of skills and diverse tasks
- Group work
- Problem-solving that requires thinking and planning
- Reflective thought through writing

- Other tasks that require meaningful thinking.

Change in pedagogy. As more and more technology programs are being implemented we are continuing to get research results that seem to suggest a connection between ubiquitous computer environments and a student-centered pedagogy (Rakes, Fields, & Cox, 2006; Russell, Bebell, & Higgins, 2004). Teachers in Boston (Russell et al., 2004) reported that it was easier to individualize instruction and that students were able to learn more independently in a one-to-one technology environment. Gillespie (2001) determined that teachers do change in several ways as they move into a technology-rich classroom. Changes included: becoming more student-centered, using more individual and group work, and including students in the planning process.

Two of the early one-to-one programs, Microsoft's Anytime, Anywhere Learning (AAL) program, and Apple's ACOT program have given us some early indicators that continual use of technology by teachers can change the teacher's pedagogical practices. Studies from these two programs have been a foundation for studying other programs that have launched in the 21st century.

The year one report from research group Rockman et al. (1997) gave us some indication that technology changes the way teachers teach. Although the teachers' data is self-reported, teachers in the first year of the program reported the following changes in teaching styles:

- Project-Based – 35% before and 61% after
- Student-Centered – 61% before and 68% after
- Interdisciplinary – 32% before and 35% after
- Traditional – 65% before and 53% after

A second year report (Rockman et al., 1998) shows us that teachers and students were using the computers more and for different purposes. Teachers reported that students' work was of higher quality and that they spent more time on tasks that were more collaborative, project-based, and required higher-order thinking skills. Correlating with the student results, the report also tells us that teachers began spending more time as facilitators, consulting with students on their work. Observations showed also that non-laptop teachers were spending 34% of their time lecturing, while laptop teachers were lecturing only 21% of their time.

A third year of the program continued to show changes in teacher practices. Rockman et al. (2004) stated in their report, "The laptop program itself, then, may be acting as a catalyst for change." In the third year report, non-laptop teachers reported that they used direct-instruction every day, but that over the three years of the project, laptop teachers had changed from doing direct-instruction almost every day to only one time each week. Compared with non-laptop teachers, laptop teachers were assigning more collaborative work and student-led inquiries in their classes (Rockman et al., 2004).

Non-laptop teachers and laptop teachers reported that they were enthusiastic about computers in education and many of them said that computers acted as the catalyst for changes in their classroom (Rockman et al., 2004). With both groups, four out of five teachers who reported making changes said that computers played a role in doing less direct instruction, in encouraging students to explore independently, in choosing their own research topics and in implementing more authentic assessment.

The Apple Classrooms of Tomorrow project (ACOT) was a decade long project that gave us a long-term view of how teachers use technology and how technology and classrooms change over time (Sandholtz et al., 1997). Although equipment did change and the structure changed over time, ACOT showed that teachers changed their pedagogy when integrating technology into their classrooms. At first, teachers were trying to implement technology into their traditional classrooms. However, as time progressed, so did the practices of the teachers.

> As one teacher in the ACOT program described, “As you work into using the computer in the classroom, you start questioning everything you have done in the past and wonder how you can adapt it to the computer. Then you start questioning the whole concept of what you originally did.” (Sandholtz et al., 1997, p. 17)

During the first year of Maine’s initial full implementation, reports on the program showed that a number of teachers did see their role in the classroom changing (Sargent, 2003). They believed that the changes were taking place because they were willing to become facilitators of learning. Teachers reported that a significant evolution had to take place in order for the classroom to change so dramatically (Sargent, 2003).

Although many teachers in the first full year of implementation of the Maine program did change, it was not a change that could be described consistently with all teachers. A glimpse of the teachers in this program was reported by Garthwait and Weller (2005), who collected data on two specific teachers in the system. Both teachers were enthusiastic about having laptops and believed that they could enhance the learning in their classrooms. However, the results were very different between the two.

Both of these teachers had very different beliefs about teaching and learning and how technology might be used. Susan felt that it was an extra and Rick felt that it allowed him to be more spontaneous. The result was that Rick saw the laptops as something that “totally changed” (Garthwait & Weller, 2005, p. 8) his classroom, while Susan felt that it was difficult for her to find time to create new lessons using the laptops.

The researchers reported that the change from teacher-centered to student-centered was something that did not happen automatically because of having a ubiquitous environment. They believe that “the effects of ubiquitous computing were strongly shaped by their beliefs about teaching and learning.” (Garthwait & Weller, 2005, p. 13). Also noted, and perhaps a reason for fewer changes, was that Susan and Rick both felt hampered by the policies that were put into place. Rick wanted to do more collaborative work, but the district would not allow the students to have First Class accounts. Susan felt the need for all of her lessons to be finished in class because students were not allowed to take the laptops home.

Piscataquis Community High School in Maine was one of the first high schools in the state to implement a one-to-one program. The state’s MLTI program was initially rolled-out to Middle Schools and then later added to high schools. The school received a grant to implement its own program, so they implemented the Microsoft Anytime, Anywhere Learning program (AAL). Reports from the third year seem to follow the reports from early studies of the Anytime, Anywhere Learning program (Rockman et al., 2000). Although the report shows that a major change in classroom practices did not occur, the laptop teachers did report using direct instruction less often and it seemed that they were becoming more constructivist and had a higher self-efficacy than non-laptop teachers.

A broader look at the Maine program shows that the new ubiquitous environment is having an effect on classroom practices and the roles of the teachers and students. Analyses of data from the first year and a half of the program (Fairman, 2004) showed that there was a shift in the pedagogy because of the program. Changes that occurred included:

- A move by teachers away from direct-instruction and more towards being facilitators.
- Less memorization and practice and more inquiry approaches.
- More collaborative learning.
- More individualized or differentiated learning.
- More interdisciplinary lessons. (Fairman, 2004)

During the 1999-2000 school year, prior to the state wide implementation of laptops in Michigan, the Walled Lake Consolidated Schools implemented a program based on the Anytime, Anywhere Learning program (AAL). Researchers followed this program for three years. During the first year of the study teachers of laptop classes were more student-centered than the teachers of non-laptop classes (Ross, Morrison, Lowther, & Plants, 2000). However, during the second and third years, the differences became less between laptop teachers and the control groups (Ross, Lowther, & Morrison, 2001; Ross, Lowther, Wilson-Relyea, Wang, & Morrison, 2003).

During the third year of the study the laptop classes were compared with classes that had access to portable carts with laptops that could be moved from class to class. Even though the study revealed a number of advantages for the laptop students, there was not a significant difference in teacher practices (Ross et al., 2003). Both groups had been through the same professional development training and both showed the same tendency to be facilitators. The study showed also that "there was infrequent use of other student-centered strategies such as cooperative learning, higher-level feedback and questioning, project-based learning, or integration of subject areas" (Ross et al., 2003, p. 13).

Even though many teachers did become more student-centered in their instructional practices when they implemented technology, it seems that the change is not automatic. Schaumburg (2001), in his early study in Germany found that students did more independent learning, but he could not make a true connection that the environment would lead to more collaborative work. Palak (2004) found that teachers who worked in technology-rich schools and had been trained to use technology were more likely to use technology in instruction, but that access alone did not move teachers towards student-centered practices.

> For some teachers, a huge leap of faith and a major philosophical shift are necessary in order to move toward a more student-centered environment, especially when many teachers are still uncomfortable with the ins and outs of technology. (Sargent, 2003, p. 14)

Barriers to change. The research shows that technology supports constructivist practices, but it also shows that the change is not automatic. A National survey of teachers in 2001 showed that the majority of teachers only used technology to support current practices and that attributes, such as years teaching, level of education, grade level(s) taught, and amount of technology-related training had little or no impact on using technology to support learner-centered instruction. This study also revealed that even though 84% of teachers supported or implemented one or more aspects of a learner-centered curriculum, only 6% had reached a level of technology implementation that showed they "could readily design learning experiences without any outside assistance that allowed students to identify and solve authentic problems using technology." (Moersch, 2001, p. 24). So, what keeps a teacher from changing how they teach using technology?

Ertmer (1999) describes the barriers to change as first and second-order barriers. First-order barriers are incremental and institutional. They include having enough access, training, and support (Ertmer, 1999). These are the barriers that are often out of the hands of teachers and left up to the schools and districts. In many cases they are budget related. Second-order barriers are ones that are more fundamental for the teacher. These are barriers that often are personal for the teacher. What a teacher believes about teaching and learning and how technology fits into learning all have a bearing on a teacher's ability to create a new technological learning environment (Ertmer, 1999).

Ertmer (1999) suggests that first and second order barriers are not necessarily independent of each other and second-order barriers can cause teachers to blame first-order barriers for their frustrations. Although she suggests that a district may want to address both kinds of barriers simultaneously, without addressing first-order barriers implementation may not be possible. Ertmer (1999) suggests four keys to addressing first-order barriers:

1. Access – acquire more equipment and find ways to maximize the use of current equipment through centralization and roving labs.
2. Time – administrators must find time for teachers to go to training and to develop lessons.

3. Training – teachers must be provided opportunities to learn in the areas of both technology and pedagogy.
4. Support – teachers need support in both technical as well as instructional areas. (Ertmer, 1999, p.6)

Adding to her work in 1999, Ertmer proposes that we begin looking at second-order barriers, more specifically teacher beliefs, in terms of experiences (Ertmer, 2005). She breaks experiences down into three categories:

1. Personal Experiences
2. Vicarious Experiences
3. Social-cultural influences (Ertmer, 2005, p.32)

A teacher's personal experience helps shape his or her personal beliefs about teaching and learning. Therefore, one's personal beliefs also might be changed through experience. Vicarious experiences that shape a teacher's beliefs would be experiences through a mentor or peer. Social-cultural influences on beliefs are shaped by the expectations and opinions of those around a teacher and by "influential others" (Ertmer, 2005, p.34).

Conceptual Frameworks for Change

Understanding the factors that affect how teachers' progress through the change process is imperative for building a successful program. The nation may call for a change, districts may set up policies and report how much they have spent on technology, but ultimately the impact of technology will be decided by how teachers allow students to use technology and how they integrate it into their classrooms. Teachers are the ones who ultimately control the change (Cuban, 2001; Hill, 2000; Sandholtz et al., 1997).

One of the earlier models used for evaluating educational change was the Concerns Based Adoption Model (Hall & Hord, 1987, 2006) or CBAM. The concepts for this model were developed by researchers at the Research and Development Center for Teacher Education at the University of Texas at Austin in the early 1970s as they began to notice that many innovations were failing. Based on Francis Fuller's work in the 1960s (Hall & Hord, 1987), they hypothesized that it was because the programs were not being allowed to fully develop and that innovation was not an event, but a process that needed to take into account the concerns of the people involved.

The CBAM model was fully developed with three diagnostic dimensions: *Stages of Concerns* (SOC), *Levels of Use* (LoU), and *Innovation Configurations* (IC; Hall & Hord, 1987, p. 13). In the case of integrating technology, the Stages of Concern would represent the different levels of how a teacher feels about the implementation. The Levels of Use represent the different stages of how the technology is being used. The Innovation Configurations represent the different configurations of the innovation. The important aspects for this study are the Stages of Concern and the Levels of Use.

In the Stages of Concern there are seven different levels: awareness, informational, personal, management, consequence, collaboration, and refocusing (Hall & Hord, 1987, 2006). Each of these stages represents the different types of concerns of a teacher as the innovative change develops. In the CBAM model teachers will have concerns in each of these areas that increase or decrease as the teacher becomes more comfortable or experienced with the innovation.

The Levels of Use (LoU) describe a teacher's behavior, rather than their feelings. These levels describe the progression that occurs in a teacher's behavior with an innovation that is different than a teacher's perceptions or feelings. In the CBAM model there are eight levels of use: nonuse, orientation, preparation, mechanical use, routine, refinement, integration, and renewal (Hall & Hord, 1987, 2006).

The CBAM Model has been the basis for many different models that have been developed to research how technology is being used in the classroom (Newhouse, 2001). It was not specifically developed to diagnose technology implementations, but it gave school personnel a way to identify the concerns of a teacher and how the teacher is implementing technology, rather than simply placing technology into a teacher's classroom and expecting positive change to automatically occur. Understanding the level of concern and level of implementation for each teacher allows the facilitator to work through the process of change with each teacher individually. "Once innovation users are confident and competent in their use of the new practice, they can afford to be more concerned about how their work is influencing students." (Hall & Hord, 1987, p. 17).

During the ACOT program teacher beliefs were identified as a major factor in changing their classroom practices. Teachers' beliefs are their source of guidance when things are uncertain and it is impossible for a teacher to simply replace those beliefs all at once. Teachers' beliefs change gradually as they gain new experiences in new situations (Sandholtz et al., 1997). Sandholtz et al. (1997) identified five different stages of teachers integrating technology: entry, adoption, adaptation, appropriation, and invention. Each phase gave teachers new experiences that allowed them to move into the next phase.

Teachers in the entry level phase typically have no experience with technology and the environment is brand new. These teachers are often more concerned with new discipline issues and getting the equipment set-up than they are integrating the technology into their lessons. During the ACOT program these teachers moved to the next level as equipment was installed and they gained more experience (Sandholtz et al., 1997).

The adoption phase showed teachers interested in integrating technology, but trying to find ways to allow the computer to support their current direct-instruction lessons. Changes in pedagogy were not visible and the teachers viewed the computer as a support tool. The Adaption phase entered as teachers had fully integrated technology into their classrooms. This phase showed students becoming more productive and taking on more challenges, which in turn allowed teachers to begin believing in the use of the technology (Sandholtz et al., 1997).

The new belief in technology, which began for teachers during the Adaption stage, moved a teacher to the phase of Appropriation. However, the researchers over the course of the program began to see this phase as a "milestone" for teachers, rather than an actual phase. It was the point in time when teachers had "come to understand technology and use it effortlessly as a tool to accomplish real work." (Sandholtz et al., 1997, p. 42).

The final phase for teachers is the Invention phase. This is the point at which teachers step out and try new practices. This is when teachers attempt to reach new heights that were perhaps not possible before. It was when teachers reached this phase in many of the ACOT schools that it was common for teachers to have interdisciplinary lessons, to team teach, to individualize instruction and to incorporate more project-based learning. (Sandholtz et al., 1997) This was the phase that teachers truly demonstrated a change in pedagogy.

The stages of adoption that were observed during the ACOT program created an understanding that change is not automatic. It is a process and teachers progress at different rates. After observing that many technology innovation programs failed because leaders did not take into account the self-efficacy issues, Dr. Chris Moersch (1995) created the Level of Technology Implementation (LoTi) Framework. Aligned with earlier and models and the work of Hall, Loucks, Rutherford, and Newlove (1975), Thomas and Knezek (1991), and Dwyer, Ringstaff, and Sandholtz (1992), the LoTi framework was developed to measure change in technology implementations.

The LoTi framework proposes eight different levels of change that a teacher progresses through as they implement technology into the classroom (LoTi Digital Age Framework, 2008):

0 Nonuse

1 Awareness

2 Exploration

3 Infusion

4a Integration (Mechanical)

4b Integration (Routine)

5 Expansion

6 Refinement

As a teacher progresses through each stage, a series of changes begin to occur. The teacher's use of technology begins by assigning tasks that only require low-level uses and moves to assigning tasks and projects that require students to use higher-cognitive processes and solve authentic problems. Instructional practices using technology change from being teacher-centered to more student-centered, and assessment strategies become varied and more authentic (Moersch, 1995).

As part of developing the LoTi Framework, Moersch also developed the Personal Computer Use (PCU) Framework and the Current Instructional Practices (CIP) Framework. The Personal Computer Use Framework measures the change in a teacher's understanding of using digital tools in the classroom as it moves from no understanding to highly fluent (Personal Computer Use (PCU) Framework, 2008). The Current Instructional Practices framework measures the change in a teacher's general instructional practice as it moves from subject-based, or teacher-centered, to learner-based, or student-centered (Current Instructional Practices (CIP) Framework, 2008).

Teacher Self-Efficacy Beliefs

Perhaps at the core of change is a teacher's self-efficacy. According to Ertmer, Ottenbert-Leftwich, and York (2006) exemplary technology-using teachers believe that confidence and commitment are the factors that distinguish teachers that integrate technology well and those that do not. Moersch (1995) believed that many programs failed because administrators did not take the self-efficacy of the teachers into account. But, if Levin and Wadmany (2006) are correct, and change involving educational technology is unique to each teacher, then how do you change a teacher's self-efficacy?

Moersch (1995) saw self-efficacy as a fundamental reason why teachers did or did not progress through stages of change. Self-efficacy suggests that people have a need to control what they do, so they will only take actions based on what they believe they can accomplish or control, not on what is actually true (Bandura, 1997). Individuals do not have an incentive to act if they don't believe that their actions can produce the desired effect (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996). Without these beliefs then individuals are less motivated, less able to handle adversity and are not as committed to goals (Bandura et al., 1996). When involved in innovations, individuals with low levels of self-efficacy may not choose the best option, but instead will choose the level that they feel they can control. Individuals with high levels of self-efficacy are more likely to accept change and will choose innovations that are the best (Moersch, 1995).

Self-efficacy is linked to motivation and to a person's environment or situation (Bandura, 1997). In the case of school teachers integrating technology, a teacher's self-efficacy will dictate the desire to implement a new tool or approach in their classroom and their commitment to the change in the face of adversity. The teacher's self-efficacy in the case of implementing a new approach also is affected by the environment, which for a teacher would be the acceptance of the instructional practice, access to resources, and support from administrators and parents (Overbaugh & Lu, 2008). If implementing technology is viewed as a process with a series of levels of change, then self-efficacy is what allows a teacher to move from one level to the next.

Finding The Factors to Change Teachers' Self-Efficacy

Based on the literature, self-efficacy plays a key role in how and to what level a teacher integrates technology into the classroom. Three factors that have been linked to teachers integrating technology into the classroom, and I believe are key to increasing a teacher's self-efficacy, are teachers' instructional practice (Overbaugh & Lu, 2008), their computer use skills (Inan & Lowther, 2010), and their experiences (Ertmer, 2005).

Instructional practices. McAdoo (2005) concluded that teachers who were more comfortable using the computer, based on Moersch's Personal Computer Use (PCU) framework were more likely to integrate technology, but that teacher instructional practices, based on the Current Instructional Practice (CIP) framework, had the most impact. “A more constructivist teaching methodology yielded a classroom where technology implementation was more likely to occur at a higher level than a classroom administered in a more traditional methodology” (McAdoo, 2005, p. 109). Rakes et al. (2006) found that as teachers progressed through the Level of Technology Implementation scale (LoTi) they became more student-centered in their instructional practices. Rakes et al. (2006) also discovered that the relationship between the LoTi score and the CIP score was stronger when it was combined with the teachers’ Personal Computer Use (PCU) score. They concluded that if a teacher was comfortable with technology, had good basic skills, and used technology in his/her classroom, he/she was more likely to use constructivist practices.

Early studies like Apple’s ACOT (Sandholtz et al., 1997) and Microsoft’s Anytime, Anywhere, Learning (AAL) program (Rockman et al., 2004), as well as current studies by McAdoo (2005) and Rakes, Fields and Cox (2006) have given us indicators that there is a connection between technology integration and student-centered, or constructivist, instructional practices. However, the issue may be more complex than it initially appears. Levin and Wadmany (2006) concur that teachers’ educational beliefs and classroom practices change after teaching in a technology-rich environment for three years, but the process is different for each individual teacher. Teacher beliefs run on a continuum from completely teacher-centered on one end to completely student-centered on the other end and multiple factors affect this change (Levin & Wadmany, 2006; Moersch, 1995).

Levin and Wadmany (2006) found that teachers held multiple views and could not easily be classified into one category. Some teachers even seemed to hold conflicting views at the same time. Chen (2008) found that the instructional practice that teachers professed and what they actually practiced was often very different. Chen's study (2008) showed that all the participants expressed very constructivist views, but their actual practices and uses of technology supported teacher-centered instruction. Chen (2008) attributed this to the fact that the teachers did not have specific guidelines and therefore based their use of technology on their own understanding and interpretations.

Palak and Walls (2009) determined that it is rare to find teachers who are actually using technology to support student-centered activities, and that even teachers in technology-rich schools, who frequently integrated technology, were using it to support teacher-centered instruction. Similar to Chen (2008), Palak and Walls (2009) determined that one of the reasons that teachers did not use technology to support student-centered practices was that they did not have any models. Hughes (2005) determined that helping teachers connect the use of technology with the subject being taught was perhaps the most effective method for getting teachers to see the connection.

Both McAdoo (2005) and Rakes, Fields, and Cox (2006) concluded that additional research needed to be performed to determine factors that affect the level of technology implementation and instructional practices. Studies have shown that in many situations, teachers become more student-centered the longer they teach using technology, but this change is not automatic. Creating programs that integrate technology for higher-level uses by means of student-centered instructional practices is a combination that improves teaching and learning, but it is imperative that the factors that affect change continue to be researched.

Computer use. Inan and Lowther (2010) found that computer proficiency has a positive affect on a teacher's level of technology integration and is one of the most important factors. This concurs with Mueller et al. (2008) whose study determined that attitudes toward technology and experience with computer technology were important variables between teachers who integrated technology successfully and those who did not. One difference between the two studies was that Mueller et al. (2008) found that years of experience, as well as gender, were not factors, but Inan and Lowther (2010) found that a teachers age and years of teaching have a negative affect on both their computer proficiency and technology integration.

Experiences. As we move deeper into the 21st century, programs seem to be addressing first-order barriers in successful ways. Programs like Maine's MLTI and Michigan's FTL program not only address access by implementing one-to-one programs, but they also have taken into account professional development and support. Although we still have first-order barriers, and perhaps new ones (Zucker & Mcghee, 2005), many programs are giving us the opportunity to more closely examine second-order barriers.

The effect of experiences also is supported by other research in organizational change and in professional development. Research by Frank, Zhao, and Borman (2004) suggests that individuals influence each other and allow access to people with expertise by drawing on membership in a common organization. In the case of schools, teachers were more likely to help other teachers that they considered to be close colleagues or they were more likely to help any teacher if they viewed the school as a collective. Garet et al.

(2001) also found that professional development can be more effective when teachers participate with other teachers from their school.

These experiences are not limited to face-to-face encounters. Wang, Ertmer, and Newby (2004) found that the self-efficacy, or teacher beliefs, of pre-service teachers to integrate technology was increased when they were able to experience successful technology integration by another teacher and that experience did not have to be in person. Experiencing another teacher’s instructional practices might typically be accomplished by physically visiting another teacher’s class, but in this case the pre-service teacher’s experience was through watching a video (Overbaugh & Lu, 2008). They found that self-efficacy also could be positively affected through an online learning community. Teachers participating in a multi-week online course that allowed the teachers to participate with other teachers online increased their self-efficacy to integrate technology.

Riel and Becker (2000) place the discussion in the context of teacher leaders and professional practice. Teacher Leaders are individuals who believe that sharing their knowledge is important. These type of teachers regularly interact with teachers in their own school concerning practices, discuss and participate in training with teachers outside of their school, participate in professional conferences, teach college level courses, and publish academic articles. The result is that teacher leaders are more likely to use constructivist methods, to have students use technology for tasks that require thinking and collaboration, and to assist students in having a high level of respect and voice in the learning community.

Based on current research, Ertmer (2005) recommends that schools consider the following additions to their programs:

- Ongoing public conversations explicating stakeholders' (teachers, administrators, parents) pedagogical beliefs, including explicit discussions about the ways in which technology can support those beliefs.
- Small communities of practice, in which teachers jointly explore new teaching methods, tools, and beliefs, and support each other as they begin transforming classroom practice.
- Opportunities to observe classroom practices, including technology uses that are supported by different pedagogical beliefs.
- Technology tools, introduced gradually, beginning with those that support teachers' current practices and expanding to those that support higher-level goals.
- Ongoing technical and pedagogical support as teachers develop confidence and competence with the technological tools, as well as the new instructional strategies required to implement a different set of pedagogical beliefs. (Ertmer, 2005, p. 35)

Professional development is one means that can change the self-efficacy of a teacher and the level that they integrate technology into the classroom (Overbaugh & Lu, 2008; Watson, 2006). Kanaya, Light, and Culp (2005) believe that the professional development should not dictate specific goals, but should start with the teacher's knowledge, needs, and interests, and allow the teacher to make further connections when they are ready. Studies also indicate that professional development needs to be very specific and intense (Hughes, 2005; Mueller et al., 2008; Shriver, Clark, Nail, Schlee, & Libler, 2010).

Mueller et al. (2008) found that teacher confidence could be enhanced when the teachers were allowed to practice using technology in their own classrooms or were able to view other teachers having success with technology. For professional development to make a difference in how a teacher uses technology in the classroom it must be specific to the teacher's content (Hughes, 2005; Shriver et al., 2010), it must focus on the relevancy of the tool for learning (Hughes, 2005), and it must demonstrate the relevancy of the pedagogy being used (Kanaya et al., 2005).

The current literature has given us some of the answers to the factors that affect how and why teachers use technology in the classroom, but more research needs to be conducted. The purpose of this study was to discover if a teacher's level of technology implementation is related to the teacher's current instructional practice, personal computer use and experiences using the DETAILS questionnaire to collect data. Since the creation of the original LoTi Framework questionnaire, Moersch has created a modified version of the questionnaire known as the DETAILS questionnaire. This version remains based on the original LoTi Framework and it will be described in more detail in the next chapter.

Chapter 3: Methodology

By continuing to discover the factors that allow teachers to integrate technology for higher-order uses, schools will have a better understanding of how to aide their teachers in moving through the stages of implementation to increase the effectiveness of programs. The purpose of this study was to discover if the instructional practices, personal computer use skills, and experiences of teachers in a private secondary school in Texas relate to their level of technology implementation.

Research Questions

1. Is there a relationship between the teacher's Level of Technology Implementation (LoTi) and Current Instructional Practice (CPI)?
2. Is there a relationship between the teacher's Level of Technology Implementation (LoTi) and the Level of Personal Computer Use (PCU)?
3. Is there a relationship between the teacher's Level of Technology Implementation (LoTi) and both the Current Instructional Practice (CPI) score and the Personal Computer Use (PCU) score?
4. Is there a relationship between the teacher's Level of Technology Implementation and the following demographics:
    - Overall Teaching Experience
    - Years of participation in the school's professional development program for creating a 21st century school
    - Age
    - Subject taught

This chapter describes the research methodology and procedures that were used in this descriptive study. This chapter is organized into the following sections: (a) description of the research design, (b) population and sample, (c) human subject concerns, (d) instrumentation, (e) validity and reliability, (f) data collection procedures, (g) data analysis, and (h) summary.

Research Design

A survey design was used to conduct this quantitative research. A survey design is used to generalize from a sample of a population to the population, so that inferences can be made about a characteristic, attitude or behavior of this population (Babbie, as cited in Creswell, 1994). An online questionnaire was used to gather information on how teachers perceive they were integrating technology into their classroom, the skills they had in using computers for classroom use, and their current instructional practices. The survey was cross-sectional in that it collected the teacher's perceptions at a single point in time. An online questionnaire was chosen because it was low cost, it allowed the participants to take the survey at a time and place of their choosing, it provided a means to administer the survey in a consistent format, and it allowed for the participants to remain anonymous to the researcher.

The researcher was the highest-level administrator of the school where the study took place, but he left the school to pursue a new career path. The researcher chose this population because the school's technology program was at a point in the plan that was identified as a time to evaluate the effectiveness of the program in order for decisions to be made to improve. This was the beginning the seventh year of the overall program, but it was the beginning of the fourth year of the one-to-one program. The one-to-one program provided a Tablet PC to all eighth-twelfth grade students for use at home and school, and the school was replacing all of those Tablets at the beginning of the year. The school was investing a significant amount of money in acquiring new technology, so it was important to evaluate the program's effectiveness in terms of how the teachers were using technology in their classrooms. Because of the relationship of the researcher with the population it was very important that the data provided allowed the participants to remain anonymous so that there low risk to the participant and they could answer the questions honestly and without fearing reprisal from their employer. Specific details on how the researcher maintained the anonymity of the participants will be explained later in this chapter.

Population and Sample

The population invited to participate in this study were all of the full and part-time faculty members who teach on the secondary campus of a Texas Private School. The school has two campuses: one campus houses the preschool and elementary grades; and the other houses the middle school and high school. The secondary campus has an enrollment of approximately four hundred students. The faculty on the secondary campus consists of forty full and part-time degreed professionals. The academic administration consists of one Head Administrator, a Director of Instructional Technology, who oversees and works on both campuses, a Secondary Principal, an Associate Principal, and an Academic Counselor who oversees the secondary program. Because of the small population size, this will be a non-random sampling, and the actual sampling will be the faculty members who choose to participate.

The goal of the technology program was to integrate technology and change classroom practices to help students develop 21st century skills. The secondary campus was beginning its seventh year of the technology program and the fourth year of the one-to-one program in high school. During the six years of the program teachers had participated in in-school training on using the computers for administrative skills, using the web-based resources subscribed to by the school, multiple intelligences, 21st century skills, creating student-centered lessons, characteristics of the Net generation, and project-based learning. Some teachers also attended state and national educational technology conferences and outside training related to integrating technology into their classrooms.

At the time of the study, students in the eighth-twelfth grades were beginning the fourth year of a one-to-one implementation and had been assigned a laptop computer for home and school use. Sixth and seventh graders had access to Tablet PC's that were in rolling carts (COWS) that could be brought to the classroom by their teachers. All computers were loaded with a full range of software for word processing, spreadsheets, presentations, video editing, graphics, sound editing, note taking, graphic organizing, multimedia, reading, and math. In addition, specialty software was loaded for students in specific classes and all teachers and students had access to a number of web resources that could be used for research, subject specific learning, and technology training. All students and teachers had access to the Internet through the school's wireless network, and could communicate through the school's communication system, which managed the school e-mail, instant messaging, calendars, and class conferences for class discussions and sharing of files. The program was supported by a full-time Director of Instruction &

Technology, a three person tech support staff that was authorized by the manufacturer to repair the laptops onsite, and a student tech support team.

In Year one technology was used primarily for administrative tasks and communication. Every teacher was provided their own desktop computer, had access to the internet through the school network, was required to use an electronic grade book and e-mail software, and was encouraged to use the two permanent computer labs that were available for student use. Discussions began with teachers and parents about 21st century skills, student-centered learning and how the school might change to meet the needs of today's students. A core of administrators, staff members and teachers attended the National Educators Computer Conference (NECC) to begin forming key leaders. Principals also attended the Principal's Technology and Leadership Academy, so that they would have a better understanding of how to lead a new technology initiative.

At the beginning of year two, teachers participated in training to understand the theory of multiple intelligences and began to discuss and implement practices that allowed students to learn using their strengths. Many teachers began to try new methods and discussions continued in department meetings on curriculum and new ideas. At the end of year two, teachers received their own Tablet PC in order to learn more about the technology during the summer.

At the beginning of year three, teachers had additional training on the theory of multiple intelligences and continued discussions on 21st century skills and how technology and student-centered learning could be implemented in each class. Portable Tablet PC labs were made available that allowed teachers to bring technology to the classroom and give each student access. At the end of this year, and throughout the summer, the teachers participated in an internal professional development program that they called CougarU. In this program all the teachers read articles on project-based learning, technology integration, and 21st century skills. Teachers would then discuss the articles on-line with fellow teachers and began shaping new ideas. At the end of the summer, teachers created projects and presentations demonstrating how they could implement 21st century learning.

The fourth year was the beginning of the one-to-one Tablet PC program. Every ninth through twelfth grade student, and eighth grade students taking courses for high school credit, were issued their own Tablet PC to be used in class and at home. Training in using the Tablets was given to students and teachers.

At the beginning of the fifth year, the school implemented training to train teacher to create lessons that used technology for higher-order thinking and student-centered learning. A small group of teachers also began training to become mentors and a peer-review program was started to allow teachers to help each other understand how to create lessons that used technology for higher-order thinking and student-centered learning. At the end of the fifth year teachers participated in training that helped them understand how Generation Y/Net Generation students were different from earlier generations.

At the beginning of the sixth year, the school hosted a teacher conference for other private school teachers in the state and many of the teachers presented on how they are integrating technology or creating student-centered lessons. The Principals and the Director of Instruction & Technology were also trained to use a new assessment form that allowed them to give teachers feedback on how their lesson rated on technology use, higher-order thinking, engaging the student, and authentic learning. The evaluation tool was loaded onto the Principals' iPhones and it allowed them to rate any lesson as they did their evaluations and it automatically loaded to the website where teachers could access their results.

At the beginning of year seven, all eighth through twelfth grade students and teachers received a new Apple laptop to be used at home and school. The older Tablet PC's were placed in portable carts and used for Elementary and Middle School classes that were not part of the one-to-one program. Teachers participated in professional development to learn to use the Apple laptops and to create project-based lessons.

As part of the teacher's professional development a number of different tools had been given to the teachers to use individually and also as evaluation tools. Those tools included a Bloom's Taxonomy wheel, the LoTi "Sniff" test, and the LoTi H.E.A.T. form. The Bloom's Taxonomy wheel assists teachers in developing questions that meet different levels on Bloom's scale. The LoTi Sniff test tool is a simple flowchart that allows a teacher or administrator to ask simple questions about a lesson to determine the LoTi (Level of Teacher Implementation) level. The LoTi H.E.A.T. (Higher-Order Thinking, Engaged Learning, Authentic Learning, and Technology Use) form allows a teacher to evaluate his or her lesson for each of these areas and is used by teachers and administrators when performing a peer-review or evaluation.

Human Subject Concerns

This survey research was conducted in an established educational setting and was evaluating normal educational practices. The participants were all over eighteen years of age and the risk to participants was minimal. The researcher was the former Head Administrator at the school where the participants of the study are employed, so in order for risk to remain low for the participants it was vital that every effort be made to allow the participants to remain anonymous while still being able to collect the necessary data. The anonymity of the participants was maintained in the following ways:

- No data was collected that could reveal the identity of a specific individual.
- The login information provided to the participants was random, so that it did not unknowingly identify the specific participant, but it remained unique in order to minimize the risk of the login information being used by more than one person, thus corrupting the integrity of the data.
- The questionnaire was online with the ability to be taken from any computer with Internet access, so that the participants could participate in the survey only if they volunteered and at place and time of their choosing. This allowed the participant to take the survey in private, so that no other person would know of their participation.
- The aggregate information was made available to school personnel, but individual information was only available to the researcher who was no longer in a position to affect the employment of a participant after the survey was taken.

Permission to do the research was retrieved from the Secondary Principal of the school. In the initial communication to the teachers concerning the research, the researcher introduced himself, the purpose of the study was explained, and a signed notice was included from the researcher and the Secondary Principal stating that the research was voluntary and that information in the study would not be used as part of the participants' performance evaluations. In addition, the researcher also emphasized that participation and individual information would remain anonymous and explained the steps taken to keep their participation and information anonymous. Specific details for keeping information anonymous is explained in the data collection section of this chapter.

Instrumentation

The instrument used for this survey was the thirty-seven question DETAILS questionnaire developed by Dr. Chris Moersch. The DETAILS questionnaire was a newer version of Dr. Moersch's original LoTi questionnaire (Stoltzfus, 2006). "The LoTi Questionnaire was created for the purpose of assessing classroom practices tied to higher order thinking skills and relevant, engaging curricula" (Moersch, 2001, p. 6). With the new DETAILS survey Dr. Moersch had expanded the original survey to focus professional development experiences relevant to the teachers' actual classroom technology implementation (Stoltzfus, 2006). Like the original LoTi questionnaire, the DETAILS questionnaire generates a profile for each participant in three domains: Level of Technology Implementation (LoTi), Personal Computer Use (PCU), and Current Instructional Practices (CIP; Stoltzfus, 2006). Each domain is supported by one or more of five factors:

Factor 1(LoTi): Using Technology for Complex Student Projects Requiring Problem Solving, Critical Thinking and Real World Applicability;

Factor 2 (PCU): Teacher Proficiency with Using Technology;

Factor 3 (CIP): Student Influences on Teachers' Current Instructional Practices;

Factor 4 (LoTi): Dependence on Resources and Assistance to Increase Comfort Level in Using Technology Practices;

Factor 5 (LoTi): Challenges to Teachers' Use of Computers in the Classroom.

The LoTi Profile created by the DETAILS survey identifies the eight different stages of implementation ranging from 0 (Non-Use) to 6 (Refinement). The CIP scale measures the teachers level of instructional practices, independent of technology use, and reveals whether the teachers' practices tends to be more subject-matter or learner-centered based on eight different levels ranging from Level 1, exclusively uses a subject-based approach to Level 7, exclusively uses a student-centered approach. Level 0 indicates that the subject is not involved in a formal classroom setting. The PCU scale is a measurement of the teachers' comfort and proficiency with computers for classroom use. The PCU scale ranges from Level 0, indicating that the teacher does not have the necessary skills to use technology for personal or classroom use, to Level 7, indicating the teacher is very fluent in using technology for classroom use.

Validity and Reliability

The original Levels of Technology Implementation (LoTi) survey was tested in 1997 and 1998. Reliability of the instrument was established using Cronbach's alpha, which showed a reliability measure of .74 for the LoTi, .81 for Personal Computer Use, and .73 for Current Instructional Practices (Schechter, 2000). The new DETAILS survey is a modified version of the original LoTi survey and it was found to be a reliable and valid instrument (Stoltzfus, 2006).

Data Collection Procedures

Because the researcher was the highest-level administrator of the school where the research was conducted, permission was requested of the Secondary Principal and the Board of Trustees for the Texas Private School. Once the permissions had been received, then the researcher prepared the information packets for the subjects. The information packet included the letter signed by the Secondary Principal and the President of the Board giving permission for the survey, the purpose of the survey, the steps taken to keep the information and participation anonymous, instructions for taking the survey, and the subjects' log-in information. In order for participation and information to remain anonymous, the log-in information could not be associated with any specific individual. Therefore, the log-in codes:

1. Were a random set of eight letters and numbers created in an excel spreadsheet.
2. Were unique and only allowed for a single occurrence of the questionnaire. This maintained the integrity of the data by only allowing each subject to answer the questionnaire once.
3. Was inserted into individual envelopes with a copy of the permission letter and study information.
4. Was sealed in the envelope, only opened by the participant.

The log-in codes were sent to Learning Quest, Inc., the owner of the LoTi Questionnaire, and the company that housed and administered the questionnaire online. Learning Quest, Inc. then added the log-in codes to the database and ensured that each log-in code was associated only with one record of the database.

The researcher created a packet that was distributed to each possible participant by the Secondary Principal. In the packet the researcher explained the purpose of the study, the time commitment for teachers to take the study, the deadline for taking the survey, and the unique log-in code. Of greater importance, the researcher explained that participation was voluntary and that participation and all information will remain anonymous, individual information will be seen by the researcher only, and that information will not be used for performance evaluations. The researcher also explained that the log-in codes were randomly generated and that they will be the only people to know their log-in code. Log-in codes were sealed in the packets by the researcher without any identifiable information on the outside of the packet. The Secondary Principal distributed the packets, so that no person knew which codes were given to which participants.

To keep each subject's information anonymous it was requested that the IRB of Pepperdine University waive the necessity to have each participant sign an acknowledgement. In its place, the first page of the online questionnaire explained all of the information given to potential participants in the packet and asked them to click the begin button to agree to participate in the study and to acknowledge that they understood their rights. Teachers were given two weeks to complete the survey and a reminder e-mail was sent every few days before the end of the survey period.

When the deadline passed, the data was scored by the automated scoring guide at Learning Quest, Inc. and a profile for each teacher was created and saved. The raw data was downloaded by the researcher and kept confidential on an external personal hard drive of the researcher. No network links were allowed to connect to the drive and the data was password protected to maintain confidentiality.

Data Analysis

Each of the five factors and the three domains were scored based on the thirty-seven questions that make up the DETAILS survey. Sixty-eight percent of the questions on the questionnaire reference the LoTi domain, nineteen percent the PCU, and fourteen percent the CIP. The LoTi domain is subdivided into three factors: Thirty-two percent of the questions reference Factor 1, Using Technology For Complex Thinking Projects; nineteen percent Factor 4, Dependence on Resources and Assistance to Increase Comfort Level in Using Technology Practices; and sixteen percent Factor 5, Challenges to Teachers' Use of Computers in the Classroom. Factor 2, Teacher Proficiency with Using Technology, is associated with the PCU domain and Factor 3, Student Influences on Teachers' Current Instructional Practices, is associated with the CIP domain.

For each non-demographic question on the survey, teachers answered on a likert scale from 0 (Not Relevant or Applicable) to 7 (Very True of Me Now) and the teachers' answers were applied against an automated scoring guide that was created by Dr. Moersch as part of the DETAILS questionnaire. The automated scoring guide assigned a level for each of the three domains: Level of Technology Implementation (LoTi score), Personal Computer Use (PCU score), and Current Instructional Practices (CIP score). Once the automated scoring guide calculated the scores for each individual participant, it calculates a mean score for each domain, creating a LoTi score, a CIP score, and PCU score for the entire sample. The database was then downloaded by the researcher for further calculations in a generic database format.

When the database had been received then the researcher the following steps were performed:

Step 1: The number of participants in the study was counted and a percentage of the total population was calculated and recorded.

Step 2: Responses that did not have a score for each domain were thrown out and the number and percentage recorded. No records had to be thrown out.

Step 3: Using Excel software, a descriptive analysis for each of the variables, LoTi, PCU, CIP, and demographic was calculated. For each domain a percentage of participants at each level was reported.

Step 4: For each Research question, the information was gathered from the online DETAILS questionnaire database. For all four research questions a multiple regression analysis was conducted using SPSS software. The analysis was used to determine the relationships of the dependent variable, Level of Technology (LoTi) score, with the independent variables, Current Instructional Practice (CIP), Personal Computer Use (PCU) score, overall teaching experience, years of participation in the school's professional development program, age, and subject taught.

Summary

The goal for integrating technology in many schools is to improve teaching and learning. Studies support that when technology is used for tasks that require higher-cognitive processing that student achievement increases. One method of evaluating a program is to discover how teachers are using technology in their classrooms. Teachers using constructivist, or student-centered, teaching methods with technology create a learning environment that promotes students using technology for higher-order thinking. What is important also for school leaders to understand is that adding technology does not automatically create this kind of environment.

Technology implementation is a process and it is important for leaders to discover the factors that allow teachers to progress through the stages of implementation. The Levels of Technology Implementation (LoTi) Framework, developed by Dr. Chris Moersch, is one conceptual model that describes the stages of implementation for teachers. Understanding how a teacher's beliefs in a constructivist, or student-centered, instructional practices, as well as their personal computer use skills, relate to progressing through the level of technology implementation can help school leaders in developing methods to increase the effectiveness of school technology initiatives.

The purpose of this study was to discover if there was a relationship between the levels of technology Implementation and teachers' instructional practices, personal computer use skills, and experiences. The 37-question DETAILS online survey, created by Dr. Chris Moersch, was used to gather data on teachers from the full and part-time teachers of a secondary private school in Texas. A Multiple-regression analysis was used to determine if relationships existed among the Level of Technology Implementation scores, the Current Instructional Practices (CIP), the Personal Computer Use (PCU) scores, and the demographic variables. This study adds to the literature concerning factors that relate to a teacher's level of technology implementation and it provides data to the leaders in the private secondary school in Texas to use in making decisions to increase the effectiveness of the technology program.

Chapter 4: Results

Research suggests that technology can increase student achievement when used for tasks that develop higher-order thinking skills (Moersch, 1999; Schacter, 1999; Wenglinksy, 2004). However, in many classrooms teachers are only using technology to support low-level cognitive tasks (Cuban, 2001; Learning Quest, Inc., 2004; Moersch, 2001, 2002). To better aide teachers in using technology with instructional practices that support higher-cognitive tasks, it is important that school leaders understand the factors that affect how teachers progress in implementing technology.

Research suggests that a teacher's self-efficacy beliefs affect how a teacher uses technology in the classroom (Ertmer & Ottenbreit-Leftwich, 2010; Moersch, 1995). Teachers' self-efficacy can be affected by their proficiency in using technology, their instructional practice, and their experiences. Other research suggests, however, that having a student-centered instructional practice and being trained to use technology still may result in teachers only using technology for low-level cognitive tasks (Cuban, 2001; Underwood, 2007). This study was designed to measure the relationship between the level of technology implementation and instructional practices, personal computer use skills, and experiences of teachers using the LoTi Details survey.

The LoTi Details Survey (Learning Connection, Inc., 2006; Stoltzfus, 2006) was used to assess levels of technology Implementation of the teachers in a private secondary school in Texas. Additional questions regarding age, subject, experience, and years of professional development were asked at the same time. This chapter presents the data collected and a preliminary analysis of the results.

Each of the forty faculty members of the school was invited to participate in the study. In order to ensure that participation was low-risk to teachers, to protect their Human Subject rights, every effort was made to keep participation anonymous. The survey was presented online to allow the participant to access the survey from any location and without anyone knowing that they participated. Every teacher was given a packet that included a unique log-in code and instructions to participate in the survey. The packets were created and sealed by the researcher and then randomly distributed by the Principal, so that teachers could anonymously participate in the survey and log-in data would not reveal their identity. To participate in the survey, participants had to first connect to the online instructions and consent page. Participants were informed of their rights and the purpose of the survey on this first page and they agreed to participate by choosing the begin button.

Participation

Participation was voluntary and twenty-one of the forty teachers chose to participate in the study. The data therefore represents 53% of the total faculty population of the school. Because the participants volunteered to participate in the study the sampling is not random, so it is possible that the results of the study are a result of a selection-bias making it more difficult to infer results to the entire population.

Table 1

Population

Population	40
Study Sample	21
Response Rate	53%

Demographics

Of the 21 participants a reasonable range of age, experiences, and subjects were represented. Tables 2, 3, and 4 represent the demographics of the participants.

Table 2

Age Frequencies

Age	Frequency	Percentage
20-29	3	14.3%
30-39	5	23.8%
40-49	5	23.8%
50-59	5	23.8%
60+	3	14.3%
Total	21	100.0%

Table 3

Teaching Experience Frequencies

Teaching Experience	Frequency	Percentage
0-4 years	5	23.8%
5-9 years	1	4.8%
10-14 years	6	28.6%
15-19 years	1	4.8%
20-24 years	2	9.5%
25-29 years	1	4.8%
30+ years	4	19.0%
Total	21	100.0%

The teaching experience of the participants represents a reasonable range from new teachers to highly experienced teachers. 23.8% of the subjects were new to the teaching profession within the last four years, with 33.3% of the teachers having twenty or more years of experience.

Table 4

Subject Frequencies

Subjects Taught	Frequency	Percentage
Math, Science or Technology	10	47.6%
English, History or Foreign Language	9	42.9%
Fine Arts	1	4.8%
Other	1	4.8%
Total	21	100.0%

Ninety point five percent of the participants teach in core academic classrooms that would have greater opportunity to use technology to support learner-based instruction. Of the 90.5%, the distribution is fairly even between the hard sciences and mathematics courses and the social science and language courses. Nine point six percent of the participants teach courses that may be considered more performance based courses and may not have the opportunity to use technology to support a learner-based instructional environment.

Table 5 represents the number of years that the participants have been involved in the professional development program that focused on technology integration, increasing higher-order thinking skills, and student-centered practices. The participants participated in the study two months after beginning the seventh year of the program. A majority of the participants, 62%, have been in the program for more than half it's life, whereas 23.8% of the participants have only been in the program for one year or less.

Table 5

Years in Professional Development Program

Years in Professional Development Program	Frequency	Percentage
1 or less	5	23.8%
2	1	4.8%
3	2	9.5%
4	5	23.8%
5	4	19.0%
6 or more	4	19.0%
Total	21	100.0%

Levels of Technology Implementation (LoTi) Results

LoTi scores ranged from Level 1 (Awareness) to Level 5 (Expansion), with no participants scoring at Level 0 (Non-use) or Level 6 (Refinement).

Table 6

LoTi Scores

Level	Description	Frequency	Percentage
0	Non-use	0	0.0%
1	Awareness	3	14.3%
2	Exploration	4	19.1%
3	Infusion	11	52.4%
4a	Integration-mechanical	1	4.8%
4b	Integration-routine	1	4.8%
5	Expansion	1	4.8%
6	Refinement	0	0.0%
Total		21	100.0%
Mean		Level 3	
Mode		Level 3	

Moersch (2001) defines Infusion stage (Level 3) to be the beginning of using technology for higher-order uses and the Integration-routine stage (Level 4b) to be the target goal for teachers to be comfortable using technology for higher-order tasks in a learner-centered environment. The majority of the teachers in this study, 86%, are below the Integration status on the LoTi scale, therefore, not using technology to support learner-centered instruction. However, over half of the teachers, 52.4%, are at the Infusion level of the LoTi scale. This implies that they are using technology to support tasks that require higher-order thinking, but they are still using technology to support teacher-centered instruction. Only 14.3% of the teachers reached the Integration level on the LoTi scale and are using technology to support learner-centered instruction. Teachers are using technology to support instruction, and a majority, 52.4%, are using technology to support higher-order thinking, but teachers seem to be stopping at the Infusion level. Moving to the Integration stage would require them to use technology to support learner-centered instruction and only 14.3% of the teachers have reached that level.

Two of the teachers that participated were in the Fine Arts or Other categories, and additional data was tabulated without their scores. They taught performance or activity type classes that would not use technology as much with the students. LoTi score frequencies and percentages were determined for the professional development categories of the teachers who taught core academic subjects and were more likely to use technology in their classroom. The professional development program had only been in place for 6 full years when the teachers were surveyed and the one-to-one laptop segment of the program had only been in place for 3 full years. Table 7, therefore, represents the LoTi scores for teachers who were hired when or after the one-to-one program started, PD Years 1-3, and PD Years 4-6+ represent the teachers who were in place before the one-to-one program began.

Table 7

LoTi Levels by Professional Development for Core Academic Teachers

LoTi Level	PD Years 1-3 Frequencies	PD Years 1-3 Percentage	PD Years 4-6+ Frequencies	PD Years 4-6+ Percentage
1	0	0%	3	23%
2	1	17%	2	15%
3	3	50%	7	54%
4a (4.0)	1	17%	0	0%
4b (4.5)	0	0%	1*	8%
5	1	17%	0	0%
6	0	0%	0	0%
LoTi Mean	3.3		2.5	
LoTi Mean without *	3.3		2.3	
CIP Mean	4.7		4.4	
PCU Mean	6.2		5.4	
Mean Experience	0-9 years		20-29 years	
Mean Age	20-39 years		40-59 years	

Thirty-four percent of the teachers who have been in the program for one to three years have reached at least a Level 4, indicating that they are integrating technology for higher-order tasks and using student-centered practices. Only 8% of the teachers who have been in the program for four or more years have reached this same level. Fifty percent of the 1-3 year teachers are at Level 3, indicating that they use technology for higher-order tasks, but they are still supporting teacher-centered practices. This compares to 54% of the teachers in the four or more category.

Loti score frequencies and percentages were also determined for teachers who taught in the two main core academic categories: Math, Science, and Technology (MST); and English, History, and Foreign Language (EHFL).

Table 8

LoTi Level by Core Academic Subjects

LoTi	EHFL		MST	
1	1	11%	2	20%
2	3	33%	0	0%
3	5	56%	5	50%
4 (4a)	0	0%	1	10%
4.5 (4b)	0	0%	1	10%
5	0	0%	1	10%
6	0	0%	0	0%
LoTi Mean	2.4		3.05	
Experience Mean	15-24 years		11-19 years	
Age Mean	40-59 years		30-49 years	

Thirty percent of the Math, Science and Technology teachers reached a LoTi Level 4a or above that indicates that are integrating technology for higher-order tasks and in a student-centered environment. Zero percent of the English, History, and Foreign Language teachers reached this level. Fifty percent 50% of the Math, Science, and Technology teachers and 56% of the English, History, and Foreign Language teachers reached a LoTi Level 3, indicating that they are integrating technology for higher-order tasks, but using teacher-centered practices.

CIP scores. The CIP scale measures the teachers' level of instructional practices and reveals whether the teachers' practices tend to be more subject-matter or learner-centered based on seven different levels ranging from Level 1, exclusively uses a subject-based approach to Level 7, exclusively uses a student-centered approach. Level 0 indicates that the subject is not involved in a formal classroom setting. Of the twenty-one teachers that participated, the range of scores for the CIP was between Level 2, exclusively a subject-matter based approach, and Level 6, supports a learner-based approach. No participants scored at Level 0, 1 or 7. A Level 5 on the Current

Instructional Practice (CIP) scale implies that "the participant's instructional practices tend to lean more toward a learner-based approach." (*LoTi Digital* Age *Framework*., 2008).

Table 9

CIP Scores

Level	Description	Frequency	Percentage
0	The participant is not involved in a formal classroom setting.	0	0.0%
1	The participant exclusively supports a subject-matter based approach to instruction.	0	0.0%
2	The participant exclusively supports a subject-matter based approach to instruction, but not at the same intensity as Level 1.	1	4.8%
3	The participant primarily supports a subject-matter based approach with teacher-directed presentations and uniform and sequential lessons, but he or she may also support more student-directed projects.	5	23.8%
4	Based on the content, the participant may use either a subject-based or learner-based approach to instruction.	4	19.1%
5	The participant tends to lean towards a learner-based approach.	8	38.1%
6	The participant supports a learner-based approach to instruction, but not as exclusively as Level 7.	3	14.3%
7	The participant exclusively supports a learner-based approach to instruction.	0	0.0%
Total		21	100.0%
Mean		Level 5	
Mode		Level 5	

The majority of the teachers in the study tend to support a learner-based instructional practice. The data represents that 23.8% of the teachers are at Level 3, which implies that they primarily use a subject-matter based approach but they may also use student-centered practices at times. The one teacher who is at Level 2, and exclusively uses a subject-matter approach, is the same teacher that is in the 'other' subject category and does not teach an academic core subject. 52.4% of the teachers, Level 5 and Level 6, either lean toward or almost exclusively use a learner-based approach to instruction, while the remaining 19.1%, Level 4, of the teachers may use either a learner-based or subject-based approach. With the mean and mode of the Current Instructional Practice (CIP) at a Level 5, the teachers in the study lean towards a learner-based instructional practice.

PCU scores. The PCU scale is a measurement of the teacher's comfort and proficiency with digital tools and resources for classroom use. The PCU scale ranges from Level 0, indicating that the teacher does not have the necessary skills to use technology for personal or classroom use, to Level 7, indicating the teacher is very fluent in using technology for classroom use. Of the twenty-one teachers that participated, the range on the personal computer use scale was from Level 4, commonly uses tools, to Level 7, very sophisticated in using digital tools. No participants scored at Levels 0,1, 2 or 3. The mean and mode PCU score for the participants was Level 6. A Level 6 on the Personal Computer Use (PCU) scale "indicates that the participant demonstrates high to extremely high fluency level with using digital tools and resources for student learning". (*LoTi Digital* Age *Framework*., 2008).

Table 10

PCU Scores

Level	Description	Frequency	Percentage
0	The participant does not have the interest or skill level to use digital tools.	0	0.0%
1	The participant has little skill level with using digital tools or resources for student learning.	0	0.0%
2	The participant has little to moderate skill level with using digital tools or resources for student learning.	0	0.0%

(table continues)

Level	Description	Frequency	Percentage
3	The participant has begun to be a regular user of digital tools and has a moderate understanding of their impact on student learning.	0	0.0%
4	The participant commonly uses digital tools and resources to support student learning.	4	19.1%
5	The participant is able to use a wide-range of existing and emerging technologies to support student learning and promotes the positive impact on student success.	5	23.8%
6	The participant has very high skill level with using digital tools and resources to support student learning, has begun to take on leadership roles advocating technology use, and reflects on the latest research.	7	33.3%
7	The participant is very sophisticated in their use of digital tools and resources for student learning, is part of setting the vision for technology infusion, and is continually seeking creative uses for digital tools.	5	23.8%
Total		21	100.0%
Mean		Level 6	
Mode		Level 6	

Based on the PCU data, the teachers in this study are generally comfortable and proficient in using digital tools and resources. All of the teachers reported that they commonly use digital tools for classroom use. However, 57.14%, Level 6 and Level 7, scored at a level that represents that they have begun to take on leadership roles advocating technology use and reflect on current research.

Multiple Regression Data

A multiple-regression analysis was performed on the data with the Level of Technology Implementation (LoTi) score being the dependent variable. Current Instructional Practice score (CIP), Personal Computer Use (PCU) score, and Demographic elements (teaching experience, years of participation in the school's professional development program, age, and subject taught) were used as the independent variables. The Multiple R value in Table 11, the Model Summary, shows that the independent variables of the model predict 37.9% of the variance of the dependent variable, LoTi score. Table 12, Coefficients, shows the significance level of each of the independent variables as they predict the independent variable.

Table 11

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.615[a]	.379	.092	1.0193

Note. a. Predictors: (Constant), Age, Subject, PCU, CIP, ProfessionalDevYears, Experience

Table 12

Coefficents

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	1.051	2.498		.421	.681
PCU	.254	.353	.258	.718	.486
CIP	.366	.311	.401	1.175	.261
ProfessionalDevYears	-.322	.246	-.573	-1.309	.213
Subject	-.489	.345	-.371	-1.416	.180
Experience	.528	.307	1.101	1.722	.109
Age	-.425	.429	-.531	-.991	.340

Note. Dependent Variable: LoTi

Table 13

Correlations

		LoTi	PCU	CIP	ProfessionalDevYears	Subject	Experience	Age
LoTi	Pearson Correlation	1	0.175	0.346	-0.28	-0.261	-0.23	-0.349
	Sig. (2-tailed)		0.449	0.125	0.219	0.254	0.329	0.121
	N	21	21	21	21	21	20[a]	21

Note. **. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

[a] One participant did not answer experience question.

It appears that there are no relationships of any of the variables to the Level of Technology implementation (LoTi) variable. In both Table 12, Coeffecients, and Table 13, Correlations, none of the independent variables showed to be statistically significant ($p<.05$) in relation to LoTi.

Research Question 1 Analysis

Is there a relationship between the teacher's Level of Technology Implementation (LoTi) and Current Instructional Practice (CIP)? This question focused on the relationship of the teacher's instructional practice (CIP) with the level that they integrated technology into their classroom (LoTi). CIP did not show a statistically significant relationship to the Level of Technology Implementation (LoTi). In Table 12 the level of significance was .261 ($p>.05$), which indicates that at a significance level of .05 a relationship between the CIP and the LoTi could not be determined. In addition to the multiple regression a correlation was performed to support the findings and in Table 13 the LoTi to CIP was 0.125 ($p>.05$). The level of CIP, as it relates to using more constructivist practices, did not show a statistically significant effect on the Level of Technology Implementation (LoTi).

Increases in the LoTi level indicate that the teacher is increasing the use of technology for higher-order thinking tasks and is increasing the use of technology to support learner-centered, or constructivist, instructional practices. Increases in the CIP indicate that the teacher is increasing the tendency to use learner-centered, or constructivist, instructional practices. To not have a relationship between the LoTi and the CIP at first seems improbable. However, it may be possible, that a teacher increases their tendency to use learner-centered instruction, but when they add technology to support instruction they choose a different instructional practice. In the case of this study, it seems that the teachers tend to lean towards a more learner-centered approach to instruction, but when they integrate technology into the lessons they revert back to a more teacher-centered approach.

Research Question 2 Analysis

Is there a relationship between the teacher's Level of Technology Implementation (LoTi) and the Level of Personal Computer Use (PCU)? This question focused on the relationship of the teacher's personal computer use with the Level of Technology implementation. Personal Computer Use (PCU) did not show a significant relationship to the Level of Technology Implementation (LoTi). The level of significance was .486 ($p>.05$), which indicates that at a significance level of .05 a relationship between the CIP and the LoTi could not be determined. In addition to the multiple regression a correlation was performed to support the findings and in Table 13 the LoTi to PCU was 0.449 ($p>.05$). The level of the teacher's Personal Computer Use (PCU) did not show a statistically significant effect on the Level of Technology implementation (LoTi).

Increases in the LoTi level indicates a change in the teacher's proficiency with implementing technology to support instruction, but it also indicates a change in the instructional practice that is used with technology. It seems that a teacher would increase their use of technology to support instruction as they became more proficient in using technology. However, this may not affect a change in the instructional practice. In this study, teachers show a high level of proficiency with using technology to support instruction, but only 14.3% of the teachers have reached the Integration Level of LoTi, indicating that they have begun using technology to support learner-centered instructional practices.

Research Question 3 Analysis

Is there a relationship between the teacher's Level of Technology Implementation (LoTi) and both the Current Instructional Practice (CPI) score and the Personal Computer Use (PCU) score? This question focused on the relationship of the CIP and PCU scores together as they related to the LoTi score. Rakes, Fields, and Cox (2006) found that the relationship with CIP and LoTi was stronger when the LoTi was combined with the PCU. A multiple regression was performed with the LoTi score being the dependent variable and the CIP and PCU scores as the independent variables.

The Current Instructional Practice (CIP) together with the Personal Computer Use (PCU) did not show a statistically significant relationship to the Level of Technology Implementation (LoTi). The Multiple R value in Table 14, the Model Summary, shows that the independent variables, CIP and PCU, of the model predict 12% of the variance of the dependent variable, LoTi score. Table 15, Coefficients, shows the significance level of each of the independent variables as they predict the dependent variable. The level of significance for the Constant was .340 (p>.05), which indicates that at a significance level of .05 a relationship between the CIP with the PCU and the LoTi could not be determined. The significance of the Current Instructional Practice (CIP) was .192 (p>.05). The significance of the Personal Computer Use (PCU) was .900 (p>.05). The level of the teacher's Current Instructional Practice (CIP), together with the Personal Computer Use (PCU), did not show a statistically significant effect on the Level of Technology implementation (LoTi).

Table 14

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.347[a]	.120	.022	1.0325

Note. a. Predictors: (Constant), CIP, PCU

Table 15

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.265	1.289		.981	.340
	PCU	.031	.239	.031	.128	.900
	CIP	.300	.222	.332	1.355	.192

Note. Dependent Variable: LoTi

Research Question 4 Analysis

Is there a relationship between the teacher's Level of Technology Implementation and the following demographics:

1. Overall Teaching Experience
2. Years of participation in the school's professional development program
3. Age
4. Subject taught

The variables teaching experience, years participating in the professional development program, age, and subject taught did not show a significant relationship to the Level of Technology Implementation (LoTi). In addition to the multiple regression a correlation was performed to support the findings and the LoTi to overall teaching experience, years participating in the professional development program, age, and subject taught all showed no statistical significance ($p>.05$). The years of teaching experience, the years that a teacher has participated in the school's professional development program, the teacher's age, and the teacher's subject all showed no statistically significant effect on the Level of Technology implementation (LoTi) and therefore a relationship could not be determined.

Summary

The purpose of this study was to illuminate factors that relate to the teachers level of technology implementation in a Texas Private School. The LoTi Digital Age Survey was used to assess the current beliefs of the teachers along with additional questions regarding age, subject, experience, and years that the teacher has participated in the school's current professional development program.

Twenty-one of the 40 teachers (53%), participated in the study by completing the LoTi Digital Age Survey. The survey revealed mean scores for the participants was Level 3 for their Level of Technology Implementation (LoTi), Level 5 for their Current

Instructional Practice (CIP), and Level 6 for their Personal Computer Use (PCU). However, there were no statistically significant relationships between the LoTi score and the CIP and PCU scores. There were also no statistically significant relationships with the LoTi score and the demographic variables of age, teaching experience, subject taught, and years of participation in the school's professional development program, taken together or separately.

The result of no statistical significant relationships may be an indication that there are other statistical significant factors that do relate and need to be explored or it is a result of statistical errors. Limitations of the study are that the result may be caused by insufficient power as a result of a small sample or it may be due to a self-selection error. The study does have a biased-sample since all of the participants volunteered. The final chapter will discuss the conclusions, additional observations of the local data, and further recommendations for studies relating to finding factors that relate to teachers' integrating technology into the classroom.

Chapter 5: Summary and Conclusions

Finding the factors that affect the level that teachers integrate technology is a critical component in the success of many technology programs. By finding these factors, school personnel will be able to develop programs to increase the effectiveness of using technology in the classroom by guiding teachers through the different levels of implementation, and thus increasing the use of technology for higher level cognitive skills and to support student-centered practices. An important factor for teachers is their self-efficacy with integrating technology into the classroom (Ertmer & Ottenbreit-Leftwich, 2010; Moersch, 1995). The higher their self-efficacy the more apt they are to integrate technology into the classroom for higher-order tasks. This research explored three factors thought to increase a teacher's self-efficacy: computer use knowledge (Inan & Lowther, 2010), instructional practice beliefs (Overbaugh & Lu, 2008), and experiences (Mueller et al., 2008).

The purpose of this study was to discover if the instructional practices, personal computer use skills, and experiences of teachers in a private secondary school in Texas relate to their level of technology implementation with the following research questions.

1. Is there a relationship between the teacher's Level of Technology Implementation (LoTi) and Current Instructional Practice (CIP)?
2. Is there a relationship between the teacher's Level of Technology Implementation (LoTi) and the Level of Personal Computer Use (PCU)?
3. Is there a relationship between the teacher's Level of Technology Implementation (LoTi) and both the Current Instructional Practice (CIP) score and the Personal Computer Use (PCU) score?

4. Is there a relationship between the teacher's Level of Technology Implementation and the following demographics:
   - Overall Teaching Experience
   - Years of participation in the school's professional development program for creating a 21st century school
   - Age
   - Subject taught

Conclusions

This study showed no statistically significant relationships between LoTi and CIP, PCU, teaching experience, age, subject taught, and years in the professional development program. These results have led to the following conclusions:

Conclusion 1: It could not be determined that having a learner-centered or constructivist instructional practice beliefs related to teachers integration of technology in a manner that supports a learner-centered practice.

Conclusion 2: It could not be determined that being proficient in using technology to support instruction related to teachers integrating technology in a manner that supports a learner-centered practice.

Conclusion 3: It could not be determined that learner-centered instructional practice and proficiency in using technology to support instruction related to teachers integrating technology in a manner that supports a learner-centered practice.

Conclusion 4: It could not be determined that experience, age, subject-taught, or years in a professional development program related to the teachers integrating technology in a manner that supports a learner-centered practice.

Discussion

The average Current Instructional Practice (CIP) score was a Level 5, which revealed that the average teacher's general instructional practice tended to be more student-centered, but not exclusively. The average Personal Computer Use (PCU) score was a Level 6, which revealed that the staff of teachers was very proficient in using technology as a learning tool for students. The Level of Technology Implementation (LoTi) score average was a Level 3, which implied that the teachers were integrating technology for higher-order thinking, but they were using teacher-centered practices. Therefore, the study could not conclude that the Level of Technology Implementation (LoTi) score had a relationship with the Current Instructional Practice (CIP) or the Personal Computer Use (PCU) scores of the teachers.

Explanations using a localized perspective. If the goal of the local program was to help teachers integrate technology for higher-order tasks in an environment that is student-centered, then there was some success in the program. After six years into the professional development program and three years since the implementation of the one-to-one program, the Level 3 LoTi average for the school implies that the teachers are integrating technology into the classrooms and using it for higher-order tasks. Moersch (2002) considers Level 3 and above to be high-level uses of technology. However, the Level 3 also implies that the uses are primarily teacher-centered. Based on the research by Schacter (1999) and Wenglinksy (2004), the school can assume that they have achieved one factor associated with higher academic achievement in the classes where teachers are using technology for higher-order thinking tasks.

All the teachers in the school have been a part of the professional development program. Therefore, the number of years that a teacher has been in the professional development program relates to the number of years that they have worked in the school, except for those that have been in the program for 6+ years. Based on the observation of teachers who teach in the core academic subjects, the LoTi level of teachers that have been hired since the one-to-one program began, years one to three in the professional development program, is almost a whole level higher than those who were hired before it started (see Table 7). If it were not for the one teacher in the four or more years category that scored a LoTi Level 4b, the difference would be a whole level. In addition, there is not a major difference in the CIP level, but almost a whole level difference for the PCU levels of each group. Upon further analysis, 84% of the teachers in the one to three year professional development category have reached a level of using technology for higher-order tasks, as compared to 62% of teachers who have been in the program for four or more years. However, only 34% in the one-to-three category and 8% of those in the four or more category have reached the level of higher-order tasks with student-centered practices.

This could be related to the fact that the teachers hired later were hired because of their current level of knowledge in working in a technology-rich school and had a higher self-efficacy that they could attain their goals using technology. It is also noted that the teachers hired after the one-to-one program began tended to be younger and have less teaching experience. This would concur with Inan and Lowther (2010) who found that a teacher’s age and years of teaching have a negative affect on both their computer proficiency and technology integration. However, this study could not determine that there was a relationship between a teacher's level of integration and the teachers'age and years of experience.

In observing the data from subject areas, the Math, Science and Technology teachers (MST) score more than a half level higher than the teachers who teach English, History and Foreign Language (EHFL; see Table 8). The only three teachers in the study to score at a LoTi level that indicated they integrated technology for higher-order thinking tasks and used student-centered practices were all in the Math, Science and Technology subject areas. In addition, the Math, Science and Technology teachers tended to be younger and have less teaching experience.

Further analysis reveals that 80% of the Math, Science, and Technology teachers in the school have reached a level of integrating technology for higher-order tasks and 30% have gone on to reach a level that also indicates the use of student-centered practices. This compares with 56% of the English, History, and Foreign Language teachers who have reached a level of integrating technology for higher-order tasks and 0% who are integrating technology with student-centered practices.

If the goal of the program is to integrate technology for higher-order tasks in a student-centered environment, because that is one indicator that technology can have an impact on student learning (Wenglinsky, 2004), then the program has certainly achieved some of its goals. 66.7% of all the teachers in the study have reached a level of integrating technology for higher-order thinking and engaged learning (LoTi Level 3 or above). 14.3% have gone on to reach levels that involve integrating technology that involved higher-order thinking in a student-centered environment (LoTi Level 4a or above). These results would include 80% of the Math, Science, and Technology teachers and 56% of the English, History, and Foreign Language teachers reaching the higher-order thinking stage, with 30% of the Math, Science, and Technology teachers going on to the student-centered environment stage. Of the remaining teachers, 19.1% of the teachers are at the LoTi Level 2 stage of integrating technology into their classroom, which implies that the students are most likely creating projects and performing tasks with technology that do not require higher-order thinking skills. The remaining 14.3% of the teachers are still using technology with students in a manner unrelated to the curriculum or assignments.

In addition to the progress in the LoTi levels, the teachers show a high proficiency with using technology in the classroom (PCU) and lean towards student-centered instructional practice beliefs (CIP). The average teacher in the study leaned towards student-centered instruction (CIP Level 5) with only one teacher using exclusively teacher-centered practices (CIP Level 2), However, this one teacher was in the ‘other’ subject category and most likely taught an activity or performance based course which would not integrate technology with students on a regular bases.

Inan and Lowther (2010) found that a teacher’s age and years of teaching have a negative affect on both their computer proficiency and technology integration. This study could not conclude that there was a relationship with a Teacher’s LoTi level and did not include researching a relationship with a teacher’s PCU. However, the average PCU level (Level 6) of the teachers showed a high skill level with technology in the classroom and that the teachers had begun to take on leadership roles in the school with using technology. No teacher was below a PCU Level 4, indicating that they commonly used technology in the classroom for learning and they were comfortable with it.

Possible reasons for relationships not being determined. Teachers who have a constructivist teaching practice, and are provided professional development that uses technology for learning, implement technology at higher levels (Moersch & Ondracek, 2005). Rakes et al. (2006) discovered that there is a relationship between the Level of Technology Implementation (LoTi) and the Current Instructional Practice (CIP). McAdoo (2005) concluded that teachers who were more constructivist in their teaching practices were more likely to integrate technology at a higher level. Gillespie (2001) determined that becoming more student-centered was one of the ways that teachers changed in technology-rich classrooms. In this school study, the teachers did tend to lean towards student-centered instructional practices (CIP), but it could not be concluded that it related to the level that the teachers integrated technology into the classroom (LoTi).

When observing the data it is possible that there are other factors involved. With the percentage of teachers integrating technology for higher-order tasks, all of the teachers scoring high on the Personal Computer Use (PCU), and the teachers reaching a level that shows that they tend towards student-centered practices, the school has some evidence that the program is moving forward. However, this study cannot support that any of the factors that were examined have a relationship to the level of integration.

With the tendency to lean towards student-centered practices it seems that this study should have concurred with the research that did find a relationship between the LoTi and the CIP. However, with only twenty-one participants it is possible that a relationship does exist, but that there was not a large enough sample to significantly find a relationship.

It is also possible that the data is not an accurate measure of teachers' instructional practices. All of the data was self-reported by the teachers, with no data collected through observations, so it is possible that the teachers' beliefs as reported on paper do not match their actual practices. Chen (2008) found that teachers who held student-centered beliefs were using technology with teacher-centered practices. He attributed this result to the fact that the teachers did not have specific guidelines and had to interpret the use of technology on their own. Levin and Wadmany (2006) found that teachers often hold multiple views and can even hold conflicting views at the same time.

When you exam the data further, what also stands out is that 56% of the teachers scored at a LoTi Level 3. So, eleven of the twenty-one teachers scored exactly the same. Since this is such a small sample, this could contribute to the belief that there is not enough data to accurately analyze, since there is very little variation in the dependent variable. Or you could look at this data and realize that teachers seem to be reaching the level of using technology for higher-order thinking tasks, but something is missing that keeps them from moving to the level of using technology with student-centered practices.

Levin and Wadmany (2006) found that teachers do change their instructional practices after teaching in a technology-rich environment for three years, and they do change on a continuum from teacher-centered to student-centered, but that every teacher responds differently. However, Palak and Walls (2009) found that it was rare to find a teacher using technology to support student-centered practices and they attributed this to the notion that the teachers did not have any models to follow. This would concur with Moersch and Ondracek (2005) and Hughes (2005). Moersch and Ondracek (2005) stated that when a teacher shows a tendency to have a high student-centered instructional practice (CIP), but a lower Level of Technology implementation (LoTi) score, then the teacher needs a model to help them understand how to use the technology for higher-levels. Hughes (2005) determined that teachers needed to have guidance in connecting technology to their specific subject area. It is possible then that this group of teachers is lacking the models that they need to take the next step. They are comfortable with technology, they lean towards student-centered practices, they are integrating technology for higher-order tasks, but they lack the model, or perhaps self-efficacy, to help them understand what it looks like to integrate technology for higher-order tasks in a student-centered environment for their subject area.

Computer proficiency has been determined to be an important factor in teachers integrating technology (Inan & Lowther, 2010) and it can be the difference between teachers that successfully integrate and those who do not. (Mueller et al., 2008). Palak (2004) found that teachers did use technology more when they worked in technology-rich schools and were trained to use technology, but that alone did not move them to become more student-centered. However, Rakes et al. (2006) determined that there was a stronger relationship with a teacher’s CIP when the teacher’s LoTi score was combined with their PCU.

This study could not determine a relationship between a teacher’s level of integration on the LoTi scale and a teacher’s Personal Computer Use (PCU) score. Mueller et al. (2008) found that years of teaching has a negative relationship with computer proficiency, however, all of the teachers in this study have reached a PCU Level 4, indicating that they commonly use technology for student learning.

Implications

Based on the average LoTi, CIP, and PCU scores, technology is being used to promote higher-order thinking, the teachers feel confident in their ability to use technology, and the teachers tend to lean towards student-centered instructional practices. However, there seems to be a separation between the teachers' beliefs about instruction and their self-efficacy to use technology for student-centered learning practices. Even though the teachers' CIP scores show that they tend to lean towards student-centered practices, when instruction involves technology the LoTi scores seem to be stopping at level 3. So, either there is a statistical error because of the sample size, Cuban (2001) is correct and pedagogy is not an issue, or a significant factor that was not measured by the study exists.

Sargeant (2003) stated that a philosophical shift had to take place with teachers for them to become more student-centered, especially when they were not comfortable with technology. In this case, the teachers in this study were comfortable with technology and leaned towards student-centered practices, but not when it related to their use of technology. Teachers are the ones who ultimately control the change in their classrooms (Cuban, 2001; Sandholtz et al., 1997). So it seems from this study, that in this Texas Private School there other factors that affect teachers moving through the process of integrating technology into their classroom.

Ertmer (1999) suggests four keys to addressing first-order barriers: access, time, training, and support. To address second-order barriers, Ertmer (2005) proposes that we begin viewing teacher beliefs in terms of three types of experiences: personal, vicarious, and social-culture influences. The Texas Private school has addressed many of these issues in their six plus year program. The implementation of a one-to-one laptop program, and providing professional development programs, have addressed many of the barriers. But in this school, a relationship with Teachers' Level of Technology Integration (LoTi) could not be determined with the teachers' Current Instructional Practice (CIP), Personal Computer Use (PCU), age, subject, teaching experience, and years of participation in the school's professional development program.

With 80% of the Math, Science, and Technology teachers and 56% of the English, History, and Foreign Language teachers already using technology for higher-order thinking tasks, the school has progressed on the Level of Technology Integration (LoTi) continuum in the three years that the one-to-one program has been in place. 30% of the Math, Science, and Technology teachers have crossed the barrier from using technology for higher-order tasks in a teacher-centered environment to using technology for higher-order tasks in a student-centered environment.

Mueller et al. (2008) found that teacher confidence could be enhanced when the teachers were allowed to practice using technology in their own classrooms or were able to view other teachers having success with technology. For professional development to make a difference in how teachers use technology in the classroom it must be specific to the teachers' content (Hughes, 2005; Shriver et al., 2010), it must focus on the relevancy of the tool for learning (Hughes, 2005), and it must demonstrate the relevancy of the pedagogy being used (Kanaya et al., 2005).

Recommendations for Additional Research

Additional research needs to be conducted to discover the factor(s) that would relate to teachers integrating technology that supports learner-based or constructivist instructional practices. Recommendations for future research include:

1. Since the sample was very small, the study should be conducted again with a higher percentage of the teachers involved.
2. Based on Chen (2008) stating that teachers' stated beliefs do not match their actual practice, perform a similar study, but use observations and surveys to determine the teachers' instructional practices and uses of technology.
3. Since teachers change over time (Levin & Wadmany, 2006; Sandholz et al., 1997), a longitudinal study should be conducted to evaluate the change in the program each year over multiple years.
4. Professional Development should be created and evaluated that targets the needs of specific teachers and allows them to practice in their own classrooms (Mueller et al., 2008), produces models for teachers to emulate (Moersch & Ondracek, 2005; Palak & Walls, 2009;), focuses on teachers' specific subject areas (Hughes, 2005; Shriver et al., 2010) and helps teachers understand the relevancy of the pedagogy being used (Kanaya et al., 2005) and the tool being used for learning (Hughes, 2005).

Summary

To better aide teachers in using technology with instructional practices that support higher-cognitive tasks, it is important that school leaders understand the factors that affect how teachers progress in implementing technology. Having a student-centered instructional practice and being proficient in using technology for classroom use are two factors that have been shown to relate to the level of technology implementation (McAdoo, 2005; Rakes et al., 2006). However, other research suggests that having a student-centered instructional practice and being trained to use technology still may result in teachers only using technology for low-level skills (Cuban, 2001; Underwood, 2007). This study was designed to measure the relationship between the Level of Technology Implementation (LoTi) and Current Instructional Practices (CIP), Personal Computer Use (PCU) skills, and experiences of teachers in a Texas Private school using the LoTi Details survey.

The results of the study did not establish a relationship between the LoTi score and the CIP, PCU, teacher's experience, age, subject taught, or years of participation in the professional development program. Therefore it could not be established that a learner-centered instructional practice or being proficient in using technology relates to using technology to support higher-order thinking tasks in a learner-centered environment. The study was also not able to conclude that teaching experience, age, subject taught, or years in the school's professional development program related to using technology in support of higher-order tasks in learner-centered instruction. However, after six years of professional development and three years of having a one-to-one laptop program, 80% of the math, science, and technology teachers and 56% of the English, History, and Foreign Language teachers reached a level of integrating technology for higher-order thinking, but with teacher-centered practices. In addition, 30% of the math, science, and technology teachers reached a level of using technology for higher-order thinking in a student-centered instructional environment. The teachers in this study tended to lean towards a student-centered instructional practice and had a high-proficiency with using technology, but the majority had not reached the stage of integration that used technology to support learner-centered instructional practices.

The results of this study did show that the teachers have made progress in using technology for higher-order tasks, but with the exception of the three math, science, and technology teachers they have not reached a level that uses technology with student-centered instruction. This could be a statistical error due to the small sample size, it could indicate that pedagogy is not a relevant factor and teachers will continue to use mixed methods (Levin & Wadmany, 2006), or the self-efficacy of the teachers is such that they need specific modeling to integrate technology at a higher level (Moersch & Ondracek, 2005). To get more information on the program, and find additional factors, it is recommended that the school continue the study and allow more time to see if teachers continue to change and perhaps target the professional development toward specific needs of the teacher (Mueller et al., 2008), help the teachers experience models (Palak & Walls, 2009), target training for specific subject areas (Hughes, 2005), help them to further understand the relevancy of the tools (Hughes, 2005) and the relevancy of the pedagogy used (Kanaya et al., 2005).

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APPENDIX A:

Table A1: Levels of Technology Implementation Framework

Table A1

Levels of Technology Implementation Framework

Level	Category	Description
0	Nonuse	At a Level 0 (Non-Use), the instructional focus can range anywhere from a traditional direct instruction approach to a collaborative student-centered learning environment. The use of research-based best practices may or may not be evident, but those practices do not involve the use of digital tools and resources. The use of digital tools and resources in the classroom is non-existent due to (1) competing priorities (e.g., high stakes testing, highly-structured and rigid curriculum programs), (2) lack of access, or (3) a perception that their use is inappropriate for the instructional setting or student readiness levels. The use of instructional materials is predominately text-based (e.g., student handouts, worksheets)
1	Awareness	At a Level 1 (Awareness), the instructional focus emphasizes information dissemination to students (e.g., lectures, teacher-created multimedia presentations) and supports the lecture/discussion approach to teaching. Teacher questioning and/or student learning typically focuses on lower cognitive skill development (e.g., knowledge, comprehension). Digital tools and resources are either (1) used by the classroom teacher for classroom and/or curriculum management tasks (e.g., taking attendance, using grade book programs, accessing email, retrieving lesson plans from a curriculum management system or the Internet), (2) used by the classroom teacher to embellish or enhance teacher lectures or presentations (e.g., multimedia presentations), and/or (3) used by students (usually unrelated to classroom instructional priorities) as a reward for prior work completed in class.
2	Exploration	At a Level 2 (Exploration) the instructional focus emphasizes content understanding and supports mastery learning and direct instruction. Teacher questioning and/or student learning focuses on lower levels of student cognitive processing (e.g., knowledge, comprehension). Digital tools and resources are used by students for extension activities, enrichment exercises, or information gathering assignments that generally reinforce lower cognitive skill development relating to the content under investigation. There is a pervasive use of student multimedia products, allowing students to

		present their content understanding in a digital format that may or may not reach beyond the classroom.
3	Infusion	At a Level 3 (Infusion), the instructional focus emphasizes student higher order thinking (i.e., application, analysis, synthesis, evaluation) and engaged learning. Though specific learning activities may or may not be perceived as authentic by the student, instructional emphasis is, nonetheless, placed on higher levels of cognitive processing and in-depth treatment of the content using a variety of thinking skill strategies (e.g., problem-solving, decision-making, reflective thinking, experimentation, scientific inquiry). Teacher-centered strategies including the concept attainment, inductive thinking, and scientific inquiry models of teaching are the norm and guide the types of products generated by students. Digital tools and resources are used by students to carry out teacher-directed tasks that emphasize higher levels of student cognitive processing relating to the content under investigation.
4a	Integration (Mechanical)	At a Level 4a (Integration: Mechanical) students are engaged in exploring real-world issues and solving authentic problems using digital tools and resources; however, the teacher may experience classroom management (e.g., disciplinary problems, internet delays) or school climate issues (lack of support from colleagues) that restrict full-scale integration. Heavy reliance is placed on prepackaged materials and/or outside resources (e.g., assistance from other colleagues), and/or interventions (e.g., professional development workshops) that aid the teacher in sustaining engaged student problem-solving. Emphasis is placed on applied learning and the constructivist, problem-based models of teaching that require higher levels of student cognitive processing and in-depth examination of the content. Students use of digital tools and resources is inherent and motivated by the drive to answer student-generated questions that dictate the content, process, and products embedded in the learning experience.
4b	Integration (Routine)	At a Level 4b (Integration: Routine) students are fully engaged in exploring real-world issues and solving authentic problems using digital tools and resources. The teacher is within his/her comfort level with promoting an inquiry-based model of teaching that involves students applying their learning to the real world. Emphasis is placed on learner-centered strategies that promote personal goal setting and self-monitoring, student action, and issues resolution that require higher levels of student cognitive processing and in-depth examination of the content. Students use of digital tools and resources is inherent and motivated by the drive to answer student-generated questions that dictate the content, process, and products embedded in the learning experience.
5	Expansion	At a Level 5 (Expansion), collaborations extending beyond the classroom are employed for authentic student problem-solving and issues resolution. Emphasis is placed on learner-centered strategies that promote personal goal setting and self-monitoring, student

		action, and collaborations with other diverse groups (e.g., another school, different cultures, business establishments, governmental agencies). Students use of digital tools and resources is inherent and motivated by the drive to answer student-generated questions that dictate the content, process, and products embedded in the learning experience. The complexity and sophistication of the digital resources and collaboration tools used in the learning environment are now commensurate with (1) the diversity, inventiveness, and spontaneity of the teacher's experiential-based approach to teaching and learning and (2) the students' level of complex thinking (e.g., analysis, synthesis, evaluation) and in-depth understanding of the content experienced in the classroom.
6	Refinement	At a Level 6 (Refinement), collaborations extending beyond the classroom that promote authentic student problem-solving and issues resolution are the norm. The instructional curriculum is entirely learner-based. The content emerges based on the needs of the learner according to his/her interests, needs, and/or aspirations and is supported by unlimited access to the most current digital applications and infrastructure available. At this level, there is no longer a division between instruction and digital tools/resources in the learning environment. The pervasive use of and access to advanced digital tools and resources provides a seamless medium for information queries, creative problem-solving, student reflection, and/or product development. Students have ready access to and a complete understanding of a vast array of collaboration tools and related resources to accomplish any particular task.

(LoTi Digital Age Framework, 2008)

APPENDIX B:

Table B1: Current Instructional Practices Framework

Table B1

Current Instructional Practices Framework

Level	Description
Level 0	A CIP Intensity Level 0 indicates that the participant is not involved in a formal classroom setting (e.g., pull-out program).
Level 1	At a CIP Intensity Level 1, the participant's current instructional practices align exclusively with a subject-matter based approach to teaching and learning. Teaching strategies tend to lean toward lectures and/or teacher-led presentations. The use of curriculum materials aligned to specific content standards serves as the focus for student learning. Learning activities tend to be sequential and uniform for all students. Evaluation techniques focus on traditional measures such as essays, quizzes, short-answers, or true-false questions, but no effort is made to use the results of the assessments to guide instruction.
Level 2	At a CIP Intensity Level 2, the participant supports instructional practices consistent with a subject-matter based approach to teaching and learning, but not at the same level of intensity or commitment as a CIP Intensity Level 1. Teaching strategies tend to lean toward lectures and/or teacher-led presentations. The use of curriculum materials aligned to specific content standards serves as the focus for student learning. Learning activities tend to be sequential and uniform for all students. Evaluation techniques focus on traditional measures such as essays, quizzes, short-answers, or true-false questions with the resulting data used to guide instruction.
Level 3	At a CIP Intensity Level 3, the participant supports instructional practices aligned somewhat with a subject-matter based approach to teaching and learning—an approach characterized by sequential and uniform learning activities for all students, teacher-directed presentations, and/or the use of traditional evaluation techniques. However, the participant may also support the use of student-directed projects that provide opportunities for students to determine the "look and feel" of a final product based on their modality strengths, learning styles, or interests.
Level 4	At a CIP Intensity Level 4, the participant may feel comfortable supporting or implementing either a subject-matter or learning-based approach to instruction based on the content being addressed. In a subject-matter based approach, learning activities tend to be sequential, student projects tend to be uniform for all students, the use of lectures and/or teacher-directed presentations are the norm as well as traditional evaluation strategies. In a learner-based approach, learning activities are diversified and based mostly on student questions, the teacher serves more as a co-learner or facilitator in the classroom, student projects are primarily student-directed, and the use of

	alternative assessment strategies including performance-based assessments, peer reviews, and student reflections are the norm.
Level 5	At a CIP Intensity Level 5, the participant's instructional practices tend to lean more toward a learner-based approach. The essential content embedded in the standards emerges based on students "need to know" as they attempt to research and solve issues of importance to them using critical thinking and problem-solving skills. The types of learning activities and teaching strategies used in the learning environment are diversified and driven by student questions. Both students and teachers are involved in devising appropriate assessment instruments (e.g., performance-based, journals, peer reviews, self-reflections) by which student performance will be assessed.
Level 6	The participant at a CIP Intensity Level 6 supports instructional practices consistent with a learner-based approach, but not at the same level of intensity or commitment as a CIP Intensity Level 7. The essential content embedded in the standards emerges based on students "need to know" as they attempt to research and solve issues of importance to them using critical thinking and problem-solving skills. The types of learning activities and teaching strategies used in the learning environment are diversified and driven by student questions.
Level 7	At a CIP Intensity Level 7, the participant's current instructional practices align exclusively with a learner-based approach to teaching and learning. The essential content embedded in the standards emerges based on students "need to know" as they attempt to research and solve issues of importance to them using critical thinking and problem-solving skills. The types of learning activities and teaching strategies used in the learning environment are diversified and driven by student questions.

(Current Instructional Practices (CIP) Framework, 2008)

APPENDIX C:

Table C1: Personal Computer Use Framework

Table C1

Personal Computer Use Framework

Level	Description
Level 0	A PCU Intensity Level 0 indicates that the participant does not possess the inclination or skill level to use digital tools and resources for either personal or professional use. Participants at Intensity Level 0 exhibit a general disinterest toward emerging technologies relying more on traditional devices (e.g., use of overhead projectors, chalkboards, paper/pencil activities) than using digital resources for conveying information or classroom management tasks.
Level 1	A PCU Intensity Level 1 indicates that the participant demonstrates little fluency with using digital tools and resources for student learning. Participants at Intensity Level 1 may have a general awareness of various digital tools and media including word processors, spreadsheets, or the internet, but generally are not using them. Participants at this level are generally unaware of copyright issues or current research on the impact of existing and emerging digital tools and resources on student learning.
Level 2	A PCU Intensity Level 2 indicates that the participant demonstrates little to moderate fluency with using digital tools and resources for student learning. Participants at Intensity Level 2 may occasionally browse the internet, use email, or use a word processor program; yet, may not have the confidence or feel comfortable using existing and emerging digital tools beyond classroom management tasks (e.g., grade book, attendance program). Participants at this level are somewhat aware of copyright issues and maintain a cursory understanding of the impact of existing and emerging digital tools and resources on student learning.
Level 3	A PCU Intensity Level 3 indicates that the participant demonstrates moderate fluency with using digital tools and resources for student learning. Participants at Intensity Level 3 may begin to become “regular” users of selected digital-age media and formats (e.g., internet, email, word processor, multimedia) to (1) communicate with students, parents, and peers and (2) model their use in the classroom in support of research and learning. Participants at this level are aware of copyright issues and maintain a moderate understanding of the impact of existing and emerging digital tools and resources on student learning.
Level 4	A PCU Intensity Level 4 indicates that the participant demonstrates moderate to high fluency with using digital tools and resources for student learning. Participants at Intensity Level 4 commonly use a broader range of digital-age media and formats in support of their curriculum and instructional strategies. Participants at this level model the safe, legal, and

	ethical uses of digital information and technologies and participate in local discussion forums that advocate the positive impact of existing digital tools and resources on student success in the classroom.
Level 5	A PCU Intensity Level 5 indicates that the participant demonstrates a high fluency level with using digital tools and resources for student learning. Participants at Intensity Level 5 are commonly able to use an expanded range of existing and emerging digital-age media and formats in support of their curriculum and instructional strategies. Participants at this level advocate the safe, legal, and ethical uses of digital information and technologies and participate in local and global learning that advocate the positive impact of existing digital tools and resources on student success in the classroom.
Level 6	A PCU Intensity Level 6 indicates that the participant demonstrates high to extremely high fluency level with using digital tools and resources for student learning. Participants at Intensity Level 6 are sophisticated in the use of most, if not all, existing and emerging digital-age media and formats (e.g., multimedia, productivity, desktop publishing, web-based applications). They begin to take on a leadership role as advocates for technology infusion as well as the safe, legal, and ethical uses of digital resources in the schools. Participants at this level continually reflect on the latest research discussing the impact of digital tools on student success.
Level 7	A PCU Intensity Level 7 indicates that the participant possesses an extremely high fluency level with using digital tools and resources for student learning. Participants at Intensity Level 7 are sophisticated in the use of any existing and emerging digital-age media and formats (e.g., multimedia, productivity, desktop publishing, web-based applications). Participants at this level set the vision for technology infusion based on the latest research and continually seek creative uses of digital tools and resources that impact learning. They actively participate in global learning communities that seek creative uses of digital tools and resources in the classroom.

(Personal Computer Use (PCU) Framework, 2008)