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Infusing Technology: A Study of the Influence of Professional Development on How Teachers Use Technology

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INFUSING TECHNOLOGY: A STUDY OF THE INFLUENCE OF PROFESSIONAL DEVELOPMENT ON HOW TEACHERS USE TECHNOLOGY

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ABSTRACT

INFUSING TECHNOLOGY: A STUDY OF THE INFLUENCE OF PROFESSIONAL DEVELOPMENT ON HOW TEACHERS USE TECHNOLOGY

This study examined whether a quality professional development course, *Infusing Technology*, influenced the use of technology by elementary and middle school teachers in West Virginia. *Infusing Technology* was designed to help school-based team learning communities use technology in their instruction while engaging students in critical thinking, reasoning, and problem solving skills.

This mixed-method study used the *LoTi Digital-Age Survey*, aligned with the National Educational Technology Standards, to collect quantitative data on levels of technology innovation, levels of personal computer use, and levels of current instructional practices. Participants in the *Infusing Technology* course completed the survey before the summer institute and after they had time to implement the content learned and focus groups were conducted following survey analysis. This allowed for pre-post comparison to determine the participants' progress integrating technology.

This study found that *Infusing Technology* did not significantly change participants' LoTi Levels from pre to post based on the evaluation of the *LoTi Digital-Age Survey*. Focus group interviews supported these conclusions. *Infusing Technology* did appear to significantly increase participants' levels of personal computer use from pre to post based on the evaluation of the *LoTi Digital-Age Survey*. Focus group interviews supported these conclusions. Infusing Technology did appear to significantly increased participants' levels of current instructional practices from pre to post based on the evaluation of the *LoTi Digital-Age Survey*. Focus group interviews supported these conclusions.

Qualitative data from focus group interviews of participants identified constraints in the LoTi survey and focus group interviews, such as: (a) a lack of time to learn, practice, plan, and use technology with students, (b) lack of sufficient technology assistance, (c) equipment failure, (d) access to technology, (e) lack of technology knowledge or expertise for substitute teachers, and (f) other priorities (e.g., statewide testing, new textbook adoptions). Participants identified enablers in the *LoTi Digital-Age Survey* and focus group interviews, such as: (a) technology support from other classroom teachers, computer teachers, and school district specialists, (b) technology support from *Infusing Technology* mentors and presenters, (c) funding for new technology tools, and (d) motivation to use technology from administration endorsement.

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CHAPTER ONE: INTRODUCTION

Students are learning new technologies at a rapid pace, and teachers are faced with the challenging task of learning to use them and how to effectively integrate them into the curriculum. Emerging 21st century digital technology Web 2.0 tools and applications such as blogs, wikis, and the use of audio and video have changed how students learn. Students must be able to use communication and networking tools to access, manage, integrate, and create information (Partnership for 21st Century Skills, 2004). They must also have technology skills to be able to research, organize, evaluate, and communicate information (Partnership for 21st Century Skills). Schools are no longer information repositories, but places where students learn how to acquire knowledge and skills to solve complex problems (Apple Classrooms of Tomorrow-Today, 2008). This has changed the role of teachers from information experts to collaborators in learning (Apple Classrooms of Tomorrow-Today). Because of this dramatic change, teachers require quality technology training in order to meet the needs of 21st century learners.

This study examined how a professional development course, *Infusing Technology*, affected the teachers who participated. A panel of experts determined *Infusing Technology* to be quality professional development based on Backus' (2005) quality professional development characteristics described in the Theoretical Framework section of this chapter. The course was designed to meet the technology integration needs of West Virginia elementary and middle school teachers. It demonstrated best practices for using technology in the classroom and offered strategies to improve students' critical thinking, reasoning, and problem solving skills in a collaborative environment.

Background

Technology Professional Development

In 2001, the U.S. Department of Education (USDE) addressed the technology needs of students through No Child Left Behind legislation in the Technology Act. This act established goals to improve student academic achievement through the use of technology (USDE, sec. 2402, 2001). This legislation recognized the importance of quality technology professional development by identifying the need for schools to enhance on-going technology professional development for teachers, principals, and administrators and promote initiatives to provide high quality training.

Recently, the American Recovery and Reinvestment Act of 2009 also provided $650 million in funds for the Enhancing Education through Technology (Ed Tech or EETT) program (USDE, 2009). The goal of this program is to improve student academic achievement by using technology in schools, and to create teacher training and curriculum development that encourages effective integration of technology. These funds enable schools to provide additional training and support for teachers to help students succeed in a global economy (USDE).

Technology Integration

The availability of technology in schools has tremendously increased, but the ability of teachers to use it effectively to enhance student learning has not. In a 2009, National Staff Development Council (NSDC) report, 76% of teachers were using technology daily for administrative purposes, 41% were using technology daily to monitor student progress, 37% for research and information, 32% for instruction, and 29% for planning and preparation of instruction (Wei, Darling-Hammond, Andree, Richardson, & Orphanos, 2009). Teachers reported that because they had not received quality technology professional development opportunities, they did not feel qualified to use technology innovatively (National Center for Education Statistics, 2000; Rakes & Casey, 2002; Stolle, 2008). In several studies (Sandholtz, 2001; Stolle, 2008; USDE, 2000b), teachers reported that they did not feel confident or prepared in their use of computers and advanced technologies. A majority of the teachers (80%) surveyed in the 2008, national Speak Up Survey (Project Tomorrow, 2009), reported they believed effective implementation of technology was a critical element to their district or school's core mission, but less than half (40%) felt their schools were effectively preparing students for 21st century jobs. In another study (SRI International, 2002), teachers reported that they needed more training in how to integrate the technology rather than basic computer skill training.

Teachers must understand how to integrate technology to teach 21st century skills. The International Society for Technology in Education (ISTE), Partnership for 21st Century Skills (P21), and the State Educational Technology Directors Association (SETDA) categorized technology integration into three roles (ISTE, P21, SETDA, 2007). The first role of technology integration is to use technology for developing 21st century skills. Students need to understand how to communicate and collaborate in a competitive workplace, and be able to analyze and solve complex problems. The second role is to support innovative teaching and learning using technology. Students must be engaged in learning while being challenged with rigorous and relevant activities. The third role is to create strong education support systems that use technology. Teachers and administrators need to have the technology tools and training to provide a 21st century education. The three roles of technology integration outline how teachers should be infusing technology into their curriculum goals.

Teachers who want to integrate technology into their instruction should understand the three types of technology integration, so they will vary their instruction to incorporate each type. Grappling's Technology and Learning Spectrum (Porter, 2002) describes how technology can be integrated into the curriculum by using levels to categorize each type of integration. Depending on the curricular goal, the teacher chooses what type of integration level is needed to teach the content. For example, if the teacher wants students to create a PowerPoint presentation based on research they have completed, then the teacher first needs to address Level 1, *Literacy Uses,* and teach students the PowerPoint features, so they are able to complete the task. The creation of the PowerPoint using the research is an example of a Level 2, *Adapting Uses* activity, for the teacher adapts the way the activity is presented by having students use PowerPoint rather than a project board or research paper. In order for the teacher to reach Level 3, *Transforming Uses* of technology instruction, the teacher would need to provide opportunities for students to collaborate, communicate, and engage in higher order thinking skills to understand a real-life problem.

Teachers who effectively integrate technology into their classrooms and achieve *transforming uses* (Porter, 2002) of technology instruction are focused on using real-life authentic problems for students to research, understand, and solve. Centering the curriculum on authentic problems and using inquiry-based or discovery learning is the focus of problem-based learning (NFIE, 1997). Problem-based learning (PBL) applies constructivist learning principles to create active learning experiences where students construct their own interpretation of knowledge (NFIE). Compared to traditional approaches, PBL has a higher long-term retention rate, an increase in skill development, and greater student and teacher satisfaction (Strobel & van Barneveld, 2009). Problem-based learning also uses a team-based learning approach that promotes higher-level thinking and interpersonal skills (Michaelsen, 2001). A problem-based learning approach provides teachers more opportunities to transform teaching and learning through the use of technology.

Theoretical Framework

Teachers must have professional development experiences that provide them with the technology skills and understanding of how to effectively integrate technology into their curriculum. Outlined in Table 1, Backus (2005, p. 178) identified six quality characteristics of staff development for teachers using the professional development criteria from the following eight organizations or legislation:

1. No Child Left Behind (NCLB)
2. United States Department of Education Professional Development Team (USDE)
3. National Staff Development Council (NSDC)
4. National Education Association (NEA)
5. American Federation of Teachers (AFT)
6. National Foundation for the Improvement of Education (NFIE)
7. North Central Regional Education Laboratory (NCREL)

8. West Virginia Department of Education Policy 550 and Professional Development Goals (WVDE)

Table 1. Common Characteristics of Quality Staff Development

	Targeted	Collaborative Environment	Sustained	Time-friendly	Reflective	Evaluated
NCLB	x	x	x			x
USDE Professional Development Team		x	x	x		x
NSDC	x	x	x		x	
NEA	x	x	x	x	x	x
AFT	x	x		x		
NFIE	x	x	x	x	x	
NCREL	x	x	x	x	x	
WVDE Policy 5500 and Professional Development Goals	x		x	x		x

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The first characteristic that Backus (2005) identified, *targeting of needs of the participants and school environment development* (p. 82), describes how the instruction should be based on the needs of the teachers to provide a meaningful experience that is motivating and pertinent. The second characteristic, *a collaborative design* (p. 82), explains how teachers should have opportunities to share knowledge and work together. The third characteristic, *a sustained, ongoing process of improvement and feedback* (p. 82), indicates that the staff development should continuously allow opportunities for the participants to apply knowledge, communicate, and reflect. The fourth characteristic, *a time-friendly process that is embedded within the daily work experience of the participants* (p. 82), looks into how staff development should be an essential component of the teacher's work schedule. The fifth characteristic, *the inclusion of reflective action* *by the participants* (p. 82), fosters reflection as a means of exploring their understandings and experiences. The sixth characteristic, *provisions for a systematic process of evaluating the impact of professional growth activities* (p.82), refers to how staff development must be evaluated to ensure the teachers are using the knowledge gained to improve student learning. These six characteristics should be embedded within a professional development course to support teachers in using the knowledge gained to improve student achievement.

Problem Statement

Professional development is a critical element in improving the use of technology in the classroom (Gorder, 2009; Mouza, 2009; USDE, 2000a). Teachers report that because they had not received quality technology professional development opportunities, they did not feel qualified to use technology effectively (National Center for Education Statistics, 2000; Rakes & Casey, 2002; Stolle, 2008). A study by SRI International (2002), found that the influence of educational technology professional development on teachers depended on the quantity of the professional development experiences, inclusion of high quality professional development research-based characteristics, and the concentration of the integration of technology during instruction. Teachers surveyed also identified the need for more training in how to integrate the technology rather than basic computer skill training (SRI International).

Lawless and Pellegrino (2007) suggest there is not enough research on creating quality professional development that is focused on improving technology integration efforts in instruction. This lack of research on how technology professional development influences teacher learning and practice (Keller, Bonk & Hew, 2005; Mouza, 2006) was motivation for this study.

Purpose of the Study

This study examined whether a quality professional development course, *Infusing Technology,* influenced teachers' integration of technology, their knowledge of digital tools and resources, and instructional practices based on responses to the *LoTi Digital-Age Survey* developed by Dr. Chris Moersch (1995). The study also identified constraints and enablers experienced by participants in integrating technology based on additional survey items and focus group interviews.

Research Questions

This study was guided by the following research questions:

1. How did the *Infusing Technology Institute* affect the teachers' levels of technology innovation?
2. How did the *Infusing Technology Institute* affect the teachers' levels of personal computer use?
3. How did the *Infusing Technology Institute* affect the teachers' levels of current instructional practices?
4. What did the teachers perceive as constraints to implementing the technology as learned from the *Infusing Technology Institute*?
5. What did the teachers perceive as enablers to implementing the technology as learned from the *Infusing Technology Institute*?

Operational Definitions

Infusing Technology Institute is a professional development course designed to assist teachers in integrating technology in their classrooms.

Teachers refer to elementary and middle school teachers from West Virginia public schools who participated in the *Infusing Technology* course, responded to the LoTi survey, and/or contributed to focus group interviews.

Level of Teaching Innovation (LoTi) is a Digital Age Framework that measures the implementation of digital-age literacy based on the National Educational Technology Standards for Teachers (NETS-T) by classroom teachers (LoTi Connection, 2009). This framework evaluates teachers' use of digital tools and resources to promote higher order thinking, student engagement, and authentic assessment practices (LoTi Connection). The LoTi levels are: 0 (*Non-use*), 1 (*Awareness*), 2 (*Exploration*), 3 (*Infusion*), 4a- (*Integration: Mechanical*), 4b (*Integration: Routine*), 5 (*Expansion*), and 6 (*Refinement*) (see Appendix B).

Level of Personal Computer Use (PCU) measures how fluent classroom teachers are with using digital tools and resources (LoTi Connection, 2009). The PCU levels are: 0-2 (*Not true of me now*), 3-5 (*Somewhat true of me now*), and 6-7 (*Very true of me now*) (see Appendix C).

Level of Current Instructional Practices (CIP) measures the instructional emphasis classroom teachers place on student directed learning (LoTi Connection, 2009). The use of instructional strategies such as varied assessments, authentic problem-solving opportunities, differentiated instruction, and cooperative learning are identified (LoTi

Connection). The CIP levels are: 0-2 (*Not true of me now*), 3-5 (*Somewhat true of me now*), and 6-7 (*Very true of me now*) (see Appendix D).

Constraints were factors identified by participants in this study that restricted or limited (Constraints, n.d.) their ability to effectively integrate technology.

Enablers were factors identified by participants in the study that helped or facilitated (Enabler, n.d.) their ability to effectively integrate technology.

Significance of the Study

This study examined whether the Infusing Technology professional development course influenced the participants' levels of technology innovation, personal computer use, and current instructional practices as measured by the *LoTi Digital-Age Survey* (Appendix E). This research adds to the body of knowledge on integration of technology in K-8 classrooms. Federal policymakers, such as The State Educational Technology Directors Association (SETDA), United States Department of Education (USDE), and the Federal Communications Commission (FCC) may use study results to support state policymakers in their efforts to improve technology integration and prioritize funding. West Virginia state organizations such as the West Virginia Department of Education, West Virginia Board of Education, and the West Virginia Governor's Advisory Council for Educational Technology (GACT) may use the identified technology integration constraints and enablers for revising policies geared toward strategic goals of students mastering or exceeding 21st century skills and learning curriculum standards (WVDE, n.d.).

Professional development coordinators may use the results from this study to assist them in creating quality technology professional development for teachers. This research may help principals and curriculum specialists in developing technology professional development designed with the specific needs of their teachers in mind. The identified technology integration constraints and enablers may also help superintendants and principals in prioritizing funding allotted for technology tools and professional development.

Delimitations of the Study

This study was limited to only 43 middle and elementary teachers in West Virginia who participated in the 2009-2010 *Infusing Technology Institute*.

Limitations of the Study

Participants in this study may have had an interest in technology prior to participation in the Institute and may have started with higher skills, thus limiting their room for growth. The survey taken by the participants was self-reported data. The professional development will be on-going, and additional technology integration development may occur beyond the scope of this study.

CHAPTER TWO: LITERATURE REVIEW

Technology Initiatives

The federal government introduced several frameworks designed to improve teaching and learning using technology. No Child Left Behind legislation created the Enhancing Education through Technology Act, (ED-TECH or EETT) which defined specific goals for schools to integrate technology (USDE, 2001). The primary goal was to improve student academic achievement using technology in both elementary and secondary schools. The US Department of Education acknowledged that assistance and encouragement to schools for the integration of technology was essential. This initiative also recognized the need for high-quality professional development programs that supported the integration of technology into curricula and instruction.

The National Education Technology Plan, another federal initiative, introduced seven major goals to improve technology integration in schools (USDE, 2004a). The first goal was to strengthen leadership by communicating to school, district, and state leaders to not only oversee technology integration but provide transformative leadership demonstrating knowledge and creativity with the use of educational technology. The second goal was to restructure and reallocate existing budgets to enable funding for technology. Improving teacher training was the third goal that stated teachers had not received sufficient training, and needed access to research, examples, innovations, and staff development to learn how to effectively integrate technology. The fourth goal provided and supported E-learning and virtual schools, so students and teachers would have access to high quality instructional opportunities. Encouraging access to high-speed, high capacity broadband communications was the fifth goal, so students and teachers could manage data online, provide online assessments, and access high-quality digital material. The sixth goal was to move away from teaching with textbooks and focused on the use of multimedia or online information. This shift required teachers to be trained in the use of online content, and provided a format to engage today's 21st century learner. The last goal was to integrate data systems to better allocate resources, improve management efficiency, and transform assessment.

Another federal initiative, The National Science and Technology Council's (NSTC) Working Group on Advanced Technologies for Education and Training, was established to identify technology tools and their application for learning (USDE, 2004b). The NSTC, the US Departments of Commerce and Education, and NetDay published *Visions 2020,* which addressed how instruction would need to change to effectively integrate technology into the curriculum. In 2004, NetDay sponsored *Speak-Up Day for Students*, which asked K-12 students nationwide about how they used technology (USDE). More than 160,000 students participated in the survey and provided several meaningful pieces of information. Students reported going online to do school activities from home. The majority of students, 83%, aged 12-17 stated that they go online more frequently at home than they do at school, but 94% of students reported that one of their reasons for going online was to complete school assignments. More than half of the students had used a school or class website, a third had downloaded a study aid, and 17% had created a web page for a school assignment. Student responses identified four major concerns towards using technology in school such as: (a) ability to use digital devices, (b) access to computers and the Internet, (c) intelligent tutors/helpers, and (d) finding more ways to learn and complete school work using technology. The concerns identified the lack of technology used by students and how students wanted to see technology used in school.

The Partnership for 21st Century Skills (2004) defined a vision for a 21st century education that requires students to be 21st century citizens, workers, and leaders. The categories created were based on student outcomes and outline technology skills, knowledge, and/or expertise such as information, media, and technology skills as shown in Table 2.

Table 2. Partnership for 21st Century Skills Framework

21st Century Categories	Skills, Knowledge, and/or Expertise
Core subjects and 21st century themes	• Subjects such as: English, reading or language arts, world languages arts, mathematics, economics, science, geography, history, government and civics • Global awareness • Financial, economic, business and entrepreneurial literacy • Civic literacy • Health literacy
Learning and innovation skills	• Creativity and innovation • Critical thinking and problem solving • Communication and collaboration
Information, media and technology skills	• Information Literacy • Media Literacy • Information and Communication Technology Literacy
Life and career skills	• Flexibility and adaptability • Initiative and self-direction • Social and cross-cultural skills • Productivity and accountability • Leadership and responsibility

Technology Integration

Computers were introduced in public schools over 40 years ago and today have advanced capabilities that could transform teaching and learning geared toward teaching 21st century skills and knowledge, but these advancements have not been integrated into the curriculum. The earliest computers did not have advanced features of today's technology tools and the Internet was cumbersome and text-based, but it was predicted that computers would change the way students were taught (Zuniga, 2009). In 1979, Bork (1980), a professor at the University of California at Irvine, gave a speech that anticipated the influence computers would have on education: "By the year 2000 the major way of learning at all levels, and in almost all subject areas will be through the interactive use of computers" (p.53). For over two decades, money was allocated to purchase computers and provide numerous professional development workshops for teachers to use them, but research has found that they are still not having a significant influence on student learning (Caverly, Peterson, & Mandeville, 1997; Oppenheimer, 1997, 2004; Trotter, 1998; Wetzel, 2001). Supplying students and teachers with technology in schools has not been enough to significantly improve teaching and learning, for teachers must understand how to integrate the technology into the curriculum.

The definition of technology integration is to incorporate technology resources and technology-based practices such as collaborative work and communication, Internet-based research, remote access to instrumentation, and network-based transmission and retrieval of data (Forum on Education Statistics, 2002). According to the Forum on Education Statistics, successful integration has to be routine, seamless, efficient and successful in support of the goals and purposes of the school. The Forum further reported that as technologies continue to change and develop, the process of technology integration must also continually change.

Pierson (2001) defines technology integration as teacher knowledge that intersects content knowledge, pedagogical knowledge, and technological knowledge. This definition acknowledges that teachers must understand more about infusing the technology than just how to use it. Pierson states,

> Technology in the hands of a merely adequate teacher will lack the experienced and thoughtful motivation necessary to embed it within a context of sound teaching practice. Conversely, technology in the hands of an exemplary teacher will not necessarily result in integrated and meaningful use. Unless a teacher views technology use as an integral part of the learning process, it will remain a peripheral ancillary to his or her teaching. (p. 427)

Technology integration, according to Grappling's Technology and Learning Spectrum (Porter, 2002), has three distinct levels of technology use and support indicators, as shown in Appendix F. The first type of technology use, *literacy uses*, views technology as the object of instruction where students learn how to use the technology by focusing on learning technology skills. The second type, *adapting uses*, supports traditional tasks and assessments using technology, but the activity is not necessary to teach curriculum standards. The third type, *transforming uses,* identifies technology as a learning and thinking tool that provides opportunities for students to collaborate, develop self-directed learning and complex thinking skills, and to communicate. Teachers should know how they are using technology in their teaching, so they are better able to vary their instruction using technology.

In order for teachers to want to use technology during instruction, they must understand how the technology will benefit them and their students, and have positive attitudes about its use in the classroom. The Technology Acceptance Model (TAM) developed by Davis (1980) provides a framework that explains and predicts user behaviors with information technology. The TAM model focuses on two cognitive responses when using technology, perceived usefulness and perceived ease of use, and demonstrates how external variables influence beliefs, attitudes, and how the technology will be used.

Once teachers understand the benefits of integrating technology, they should understand the process that teacher's go through to identify best teaching strategies using technology tools. From 1986-1989, Apple Classroom of Tomorrow (ACOT) provided teachers with technology and conducted multiple studies focused on the influence the technology had on teaching and learning (Dwyer, Ringstaff, & Sandholtz, 1990). These studies examined multi-perspective data, such as teachers' personal reports, weekly site reports, classroom observations, and interviews with teachers, parents, and students. Based on the data, the ACOT determined that teachers went through five stages, and the Instructional Evolution in Technology-Intensive Classrooms Model was created. This model describes each stage of technology integration: (a) entry, (b) adoption, (c) adaptation, (d) appropriation, and (e) invention. Each stage, described in Table 3, gradually replaced lecture and recitation instruction with more innovative teaching strategies.

Table 3. ACOT's Instructional Evolution in Technology-Intensive Classrooms Model

ACOT's Five Stages	Stage Descriptions
Entry	Technology was introduced to classroom. Problems such as resource management, discipline, and frustration occurred.
Adoption	Teachers struggled to use new technology and learning was disrupted.
Adaption	Students began to improve productivity and were more engaged.
Appropriation	Teachers understood how to use technology and used it effortlessly. Students worked on more collaborative projects.
Invention	Teachers were ready to begin changing instruction to include interdisciplinary learning activities.

Another technology integration model was developed from Russell's (1995) four-year study on more than 400 teachers at Queensland University of Technology. The model emerged from the teachers' informal diaries of their experiences in learning to integrate email into their curriculum. Russell's Learning to Use Technology Model contains six stages that teachers progress through as they learn to use technology. The six stages, described in Table 4, range from awareness to creative applications in new contexts.

Table 4. Russell's Learning to Use Technology Model

Russell's Six Stages	Stage Descriptions
Awareness	Learner was aware that technology exists, but had not used it.
Learning the Process	Learner required extensive support if he wanted to avoid frustration and loss of confidence. Technology was intrusive.
Understanding and application of the process	Learner no longer needed constant support and began to see how the technology can be applied to instruction.
Familiarity and confidence	Learner became familiar with technology and confidence had risen.
Adaptation to other contexts	Learner became focused on other uses of the technology.
Creative application to new contexts	Learner applied technology to other purposes.

Technology and Instruction

Technology integration that supports constructivist principles establishes an encouraging learning experience for students. Carvin's (2004) literature review noted constructivism was a blend of Dewey, Vygotsky, and Piaget's research that supported the notion that students actively learn. Constructivism promoted student collaboration and used prior knowledge to interpret, articulate, and re-evaluate information as a means of demonstrating students' understanding.

Bruner (1973) suggested there were three principles of constructivist classroom instruction. The first principle is that instruction must be concerned with the experiences and contexts that make students ready and willing to learn. The second is that instruction should be structured so that it can be easily understood by students. Lastly, the instruction should be designed to facilitate students, so they may go beyond the information to fill in any gaps.

Constructivist principles are typically used when teachers implement technology. One constructivist centered framework designed to help school districts restructure curricula to incorporate concept/process-based instruction, authentic technology uses, and qualitative assessment is the Levels of Teaching Innovation (LoTi) framework (Moersch, 1995). The LoTi framework, developed by Moersch, is conceptually aligned with the ACOT stages, Concerns Based Adoption Model (CBAM, described on pg. 30), and Moersch's (2001) observations of hundreds of classroom nationwide. This framework identifies teaching practices that gradually replace traditional verbal instruction with more hands-on inquiry based lessons, and students are evaluated by multiple assessment strategies such as portfolios, open-ended questions, self-analysis, and peer review

(Moersch, 1995). Since 1995, the Levels of Teaching Innovation (LoTi) framework has transformed into four frameworks: (a) LoTi Digital-Age, (b) Current Instructional Practices (CIP), (c) Personal Computer Use (PCU), and (d) Higher-order thinking, engaged learning, authentic learning, and technology use (H.E.A.T.). These frameworks measure the intensity of technology instructional practices of teachers (LoTi Connection, 2009).

The LoTi Digital-Age Framework identifies seven discrete levels of teacher implementation of technology that describe changes in instruction from a teacher-centered to a learner-centered curriculum (Moersch, 1995). The LoTi levels are:

- Level 0 Non-use
- Level 1 Awareness
- Level 2 Exploration
- Level 3 Infusion
- Level 4a Integration: Mechanical
- Level 4b Integration: Routine
- Level 5 Expansion
- Level 6 Refinement

The LoTi Framework, as shown in Table 5, is aligned with essential characteristics of the following instructional strategies: (a) Daggett's Rigor/Relevance Framework, (b) Marzano's research based practices, (c) Wiggins and McTighe's Understanding by Design, and (d) Webb's Depth of Knowledge (LoTi Connection, 2009).

Table 5. LoTi Digital-Age Framework

Levels	Instruction	Learning	Technology Use
Level 0 Non-use Level 1 Awareness	Traditional direct instruction approach; Lecture/discussion, teacher-created multimedia presentations.	Lower cognitive skill development	Digital tools and resources are not in use. Curriculum management, attendance, grading, enhancing teacher's lectures.
Level 2 Exploration	Emphasizes content understanding and supports mastery learning and direct instruction.	Lower levels of cognitive processing	Digital tools/resources used for extension activities, enrichment, student presentations.
Level 3 Infusion	Instruction emphasizes student higher order thinking, problem solving, decision-making and reflection.	Higher levels of cognitive processing	Digital tools and resources emphasize higher levels of student cognitive processing related to content. Teacher-directed tasks.
Level 4a Integration: Mechanical	Classroom management/school climate issues may restrict full-scale integration. Emphasis placed on applied learning and constructivist models.	Students explore real-world issues and solve authentic problems (PBL) using digital resources.	Use of digital tools and resources motivated by student-generated questions that control the content, process, and products in activities.
Level 4b Integration: Routine	Teacher uses inquiry-based model with emphasis on learner-centered strategies.	Students highly engaged in real-world explorations, solving authentic problems, and resolving issues.	Digital tools and resources are used.
Level 5 Expansion	Emphasis on learner-centered strategies.		Students use sophisticated and complex digital tools and resources.
Level 6 Refinement	Content based on needs and interests of the learner	Authentic student problem-solving and resolving issues promoted by collaborations extending outside of the classroom.	Students are creatively problem solving, reflecting, and/or developing products using collaborative tools & resources. Unlimited technology access.

The Rigor/Relevance Framework, aligned with the LoTi Framework, was developed by the International Center for Leadership in Education to examine curriculum, instruction, and assessment (Daggett, 2008). The Application Model, created by Daggett, describes how knowledge is put to use by categorizing levels of thinking and student learning. Daggett used Bloom's Taxonomy of Knowledge and Application Model (Bloom, 1956) to create the Rigor/Relevance Framework to evaluate higher standards and student achievement (Daggett, 2008). Bloom's (1956) taxonomy describes the levels of complex thinking ranging from acquiring knowledge to using the knowledge in logical and creative ways. Daggett's (2008) Application Model promotes:

1. Knowledge in one discipline
2. Apply in discipline
3. Apply across disciplines
4. Apply to real-world predictable situations
5. Apply to real-world unpredictable situations

Marzano's research on instructional strategies that affect student achievement also align with the LoTi Framework Marzano, Pickering, & Pollock 2001). Marzano examined 21 research studies and conducted a meta-analysis to discover nine instructional strategies that significantly influenced student achievement (Marzano, Pickering, & Pollock, 2001) as shown in Table 6.

Table 6. Marzano's Instructional Strategy Categories and Student Gain

Instructional Strategy Category	Percent Gained
Identifying similarities and differences	45
Summarizing and note taking	34
Reinforcing effort and providing recognition	29
Homework and practice	28
Nonlinguistic representations	27
Cooperative learning	27
Setting objectives and providing feedback	23
Generating and testing hypotheses	23
Questions, cues, and advance organizers	22

Wiggins and McTighe's (2005) *Understanding by Design* also aligns with the LoTi framework. Wiggins and McTighe described a three-stage planning approach termed *backward design*, starting with what the student will learn and how the teacher should begin considering activities during the planning process. The three stages are: (a) identify desired results, (b) determine acceptable evidence, and (c) plan learning experiences and instruction.

The Webb Depth of Knowledge framework also aligns with the LoTi Framework. This framework is similar to Bloom's Taxonomy in that it categorizes the process of how people critically think (Webb, 2006). Each of Webb's four levels – Recall, Skill/Concept, Strategic Thinking, and Extended Thinking – provide key terms ranging from memorize and define (*level one*) to analyze and synthesize (*level four*). Webb's Framework also provides examples of activities that align with each level.

The LoTi Framework, Daggett's Rigor and Relevance, Marzano's research-based best practices, Wiggins and McTighe's *Understanding by Design*, and Webb's Depth of Knowledge all align with Problem-based Learning (PBL). PBL is a learner-centered approach that defines a problem and learners conduct research and apply knowledge and skills to create a feasible solution (Savery, 2006). Students are not led down specific paths of learning outcomes (Strobel & van Barneveld, 2009), for there is not one *right* answer to an open-ended problem (Learning Theories Knowledgebase, 2009). Rather than providing knowledge to students, PBL requires teachers to be facilitators of learning who manage the process of learning by creating tasks and conditions where student thinking involves inquiry, dialogue, and skill building (Buck Institute of Education, 2007). Teachers who integrate technology using a PBL framework are able to transform the curriculum to provide students with a more hands-on, authentic, collaborative learning environment.

Problem-based learning uses Inquiry-based learning or Discovery-based learning teaching methods that emphasizes discovery and exploration while students are encouraged to develop curiosity, questioning, and systematic investigation skills (NFIE, 1997). PBL is designed to encourage students to discover, filter and integrate information rather than just acquire content (Keeling, 2008), in order to practice what Bloom (1956) categorizes as *higher-order* thinking skills. Students learn how to plan and communicate in a rigorous, relevant, and engaging environment that supports authentic inquiry and student autonomy (Buck Institute of Education, 2007). PBL teachers stress higher order thinking skills and use performance-based authentic assessments (Stites, 1998). Teachers guide students through the learning process and promote an inquiry driven environment where they become facilitators of learning (Learning Theories Knowledgebase, 2009).

A Meta-synthesis study was conducted on eight meta-analysis or systemic reviews that identified the effectiveness of PBL on student learning rather than the traditional approach (Strobel & van Barneveld, 2009). This research found that compared to traditional teaching practices, students learning in a problem-based learning curriculum were significantly more competent and skilled, had more long-term retention of knowledge, and had higher scores on standardized tests that required more elaboration than a multiple choice or true or false answer. In addition, students and faculty were overall more satisfied with the PBL approach.

PBL strategies are often implemented using collaborative interactions with peers (Michaelsen, 2001). Students actively work in a team which facilitates *learner empowerment* and are encouraged to take responsibility for their own learning outcomes (Healey & Matthews, 1996). A well-designed collaborative experience that offers opportunities for students to develop team skills and reflect on their learning can foster student engagement and concept retention (Chappell, 2006).

Problem-based learning also provides an authentic context to increase students' information literacy skills (NFIE, 1997), which is one of the major goals in the Partnership for 21st Century Skills (2004) Framework. The American Library Association (ALA) defines information literacy as the ability to find the necessary information, evaluate and organize the information, and use it effectively to solve the problem (Breivik & Senn, 1994, as cited in NFIE). For example, students must go beyond traditional resources such as textbooks and encyclopedias to locate additional sources of information on the Internet or CD-ROM.

Technology Use

Two LoTi related frameworks, the Personal Computer Use (PCU) Framework and the Current Instructional Practices (CIP) Framework, are designed to measure how fluent the teacher is with using digital tools and resources for student learning and the teacher's instructional practices in the classroom (LoTi Connection, 2009). The PCU framework identifies the intensity and extent of current and emerging technology use in the classroom. As the teacher moves to each PCU level the amount of dedication to the technology's use increases, as shown in Table 7. The teacher progresses to higher CIP levels as he uses less traditional approaches to instruction and begins to use more learner-based instructional strategies, such as student-directed learning, varied assessment, authentic problem-solving and differentiated instruction, as shown in Table 7.

Table 7. Personal Computer Use and Current Instructional Practice Frameworks

Levels	PCU	CIP
Level 0	Teacher does not have the skills to use digital tools and resources for personal or professional use.	Teacher is not teaching in formal classroom setting.
Level 1	Teacher shows very little knowledge or skill for using digital tools and resources. Teacher does not understand the importance of using technology and is unaware of copyright issues.	Teacher using mainly lectures and teacher-led presentations. Subject-matter based approach to teaching and learning. Traditional evaluation.
Level 2	Teacher demonstrates some knowledge or skill for using digital tools and resources, but does not have the confidence to use technology with students. Teacher is somewhat aware of copyright issues.	Teacher uses traditional instruction and may allow teacher-directed student projects. Instruction not differentiated.
Level 3	Teacher may begin to regularly use technology for communication and show students how to use it for research. Teacher is aware of copyright issues and understands the impact technology has on teaching and learning.	Teacher may allow student directed projects that allow for differentiated instruction, but mainly traditional forms of teaching and learning. Traditional evaluation.
Level 4	Teacher uses a broader range of digital tools and resources to teach curriculum standards. Teacher is an advocate for using digital tools and resources, and understands copyright issues.	Subject-matter or learner-based approach depending on content. Alternative assessments may be offered. Some differentiated instructional strategies used.
Level 5	Teacher is fluent in using digital tools and resources in teaching and learning. Advocate of safe, ethical uses of technology and local and global learning.	Instruction tends to be more learner-based. Students learn critical thinking skills and use real-world problems. Performance assessment used.
Level 6	Teacher is very fluent in using digital tools and resources in teaching and learning. Teacher has knowledge of emerging technologies. Leadership roles begin to form as teacher reflects on current research in technology integration.	Instruction supports learner-based approach. Substantial amount of differentiated instructional methods used. Performance assessment created by students, teachers, and occasionally parents.
Level 7	Teacher is extremely fluent in using digital tools and resources in teaching and learning. Teacher actively participates in global learning communities and uses current research to creatively infuse technology.	Instructional practices exclusively learner-based. Differentiated instruction.

There are common characteristics of teachers who integrate technology effectively. Becker (1994) studied teachers who were identified as having exemplary computer usage based on the research of Sheingold and Hadley. Becker examined how exemplary teachers differed in their school and classroom environment, backgrounds and experiences, ways they taught, and perceptions about teaching and computer use compared to teachers who were not identified as exemplary. This study suggested that exemplary teachers used computers for students to play simulation games, write, publish, and to prepare for the workplace, and spent more than twice the amount of time during school using computers than did non-exemplary teachers. Exemplary teachers had social networks of computer-using teachers and technology support from full-time computer coordinators and staff development activities at their school, and had significantly more formal computer training. They also had accumulated significantly more college credits and degrees than their counterparts. In addition, their schools acknowledged that teachers needed smaller class sizes, and resources to effectively use computers.

Providing teachers and students with resources and technology tools is crucial, but access alone does not transform teaching and learning. Cuban, Kirkpatrick, and Peck (2001) surveyed, observed, and interviewed 21 teachers and 26 students in two high tech high schools in California to identify if technology was influencing their teaching practices. Their study found that access to computer technology did not influence the amount of integration, and that it would be a slow process for teachers to use technology innovatively. Very few teachers used technology for student-centered instructional practices, and traditional instructional practices were not altered due to occasional or even frequent use of computers. Teachers reported barriers such as time, standardized testing pressure, inadequate software and machines, technical problems, and limited technology support personnel. Schools have been more focused on providing teachers and students with technology and software than in changing instruction and assessment (Dwyer, Ringstaff, & Sandholtz, 1990).

Changing the way teachers teach is a difficult process that requires an understanding of how this process occurs. There are several change models that illuminate experiences teachers may have as they integrate technology into the curriculum. One of the original change models, Rogers' (1962) Innovation-Decision Process explains how innovations are accepted into cultures. His five stage model, described in Table 8, suggests that the eagerness of the adopter affects the rate at which the innovation spreads from *Knowledge* to *Persuasion* to *Decision* to *Implementation* to *Confirmation*.

Table 8. Rogers' Innovation-Decision Process

Rogers' Five Stages	Stage Descriptions
Knowledge	Individual is exposed to the innovation's existence and begins to understand its functions.
Persuasion	Individual seeks information to develop an opinion about the innovation.
Decision	Individual decides whether or not to accept or reject innovation.
Implementation	Individual puts innovation to use.
Confirmation	Individual searches for reinforcement of his decision, but may reverse previous verdicts if shown inconsistent results.

One of the changes in instruction is that teachers need to teach students how to use the technology before they could integrate it into the curriculum. The *Just-in-Time Model* suggests that teachers should explain and demonstrate the technology tools only when students are ready to use them. This would eliminate any time wasted, for students need to know how to use only the tools they would need to operate. McKenzie (2003) suggests that teachers use *Just-in-Time* technology instruction to avoid the *Just in Case* teaching technology tools model which provides students with technology training before the purpose, value, or strategy is understood. Warschauer and Grimes (2005) supports the use of *Just-in-Time* instruction because students will use and remember information if received at the point of need. Using *Just-in-Time* technology instruction will ensure that students know how to use technology features they will need to operate when using technology.

Technology Enablers

Hall and Hord (1987) researched how schools might initiate change processes and suggested that people must have support and their needs met when trying to implement a new practice. Hall and Hord (2001) created a change model, the Concerns Based Adoption Model (CBAM) that describes seven stages of concern people have when experiencing change. This model was also used in research studies (Porterfield, 2006; Serotkin, 2006) to examine teachers' change processes as they integrated technology and compared that to student achievement. The CBAM stages are:

1. *Awareness*- User has few concerns or involvement with the innovation.
2. *Informational*- User is generally aware of innovation and wants to learn more.
3. *Personal*- User is unsure about innovation demands and lacks confidence in using it.
4. *Management*- User is attempting to use innovation and dealing with organization, management, time demands, efficiency, and scheduling issues

5. *Consequence*- User is attempting to use the innovation to provide students with relevant activities, assess student projects and evaluation of innovation to enhance learning.
6. *Collaboration*- User is coordinating and cooperating with others using the innovation.
7. *Refocusing*- User has alternative ideas on the innovation's use.

Support for teachers learning to integrate technology is crucial for integration to be successful. Toledo (2005) researched pre-service teachers and their efforts to integrate technology at three private colleges in California that used a computer technology infusion model in their teacher education programs. Focus groups, interviews, and surveys were used to determine the stages and processes of how teachers and students learned to integrate technology. Using results from this study, Toledo developed a five-stage developmental model of computer technology use and integration: (a) pre-integration, (b) transition, (c) development, (d) expansion, and (e) system wide integration. Each stage identified technology integration enablers such as increased technology resources, support, and professional development. This model demonstrates the importance of a support system for teachers as they infuse technology into the curriculum.

Teacher support is imperative for the success of technology integration in schools, and according to Porter (2002) there are four areas, *Grappling's Four Cornerstones*, that are the foundation of technology integration change support. Each area must be directly addressed for teaching and learning to be influenced by using technology. The first area, *Readiness for Change*, suggests that the attitude, energy, and commitment of teachers are vital to integrate technology. The second area, *Teaching and Learning*, states that technology efforts must be centered on the learning of students rather than learning how to use technology. *Technology Deployment* is the third area which addresses the need for resources to be distributed according to the needs of the students. The last area, *System Capacity*, focuses on the ability of school systems to put the right amount of pressure on teachers to use technology, so resistance does not happen.

The support of teachers will help ensure technology is effectively integrated into teaching and learning, and a 21st century support system will ensure that students master 21st century skills. The Partnership for 21st Century Skills (2009) developed a list of skills students must have to compete in a global workplace such as information media and technology and learning and innovation skills, global awareness, and civic literacy. In order to effectively teach these skills, teachers need a 21st century support system. The Partnership for 21st Century Skills identified five support systems to technology integration:

1. 21st century standards
2. Assessment of 21st century skills
3. 21st century curriculum and instruction
4. 21st century professional development
5. 21st century learning environments

Technology Constraints

Historically, teachers have had several concerns when trying to integrate technology into the curriculum. Rakes and Casey (2002) administered the Stages of Concern Questionnaire (SoCQ), developed from the CBAM change model, to over 600

PK-12 teachers nationwide who had subscribed to four email listservs and used some types of instructional technology. The study identified concerns teachers had in using instructional technology, such as not understanding the technology's potential or real purpose in their teaching which was the highest concern identified. Teachers also expressed high concerns about working with colleagues to coordinate the use of technology. Over half, 68%, expressed concern that they were not given any time during the work day to practice technology skills that they had been taught.

Recently, a study by Hew and Brush (2007) evaluated 48 empirical studies and identified six major categories that categorized the 123 barriers found. The categories, percentages of teachers who identified the category as a barrier, and a general description of the barrier category are shown in Table 9.

Table 9. Hew and Brush's Technology Barriers

Major Categories	Percentage Reported	Description
Resources	40%	Technology, access to appropriate technology, time, and technical support.
Knowledge and skills	23%	Technology knowledge and skills, technology-supported pedagogical knowledge and skills, and technology-related-classroom management knowledge and skills.
Institution	14 %	Leadership, class schedules, and school planning.
Attitudes/ beliefs	13%	Positive or negative feelings toward technology and beliefs about technology and influence on learning.
Assessment	5%	Pressures related to high-stakes testing.
Subject culture	2%	Typically shaped by the subject content, subject pedagogy, and subject assessment (Selwyn, 1999, as cited in Hew & Brush).

A recent qualitative study was conducted on the use of information and communication technologies (ICT) of 16 high school teachers using observations, individual interviews, and focus group interviews (Stolle, 2008). This study identified four major tensions of teachers who tried to use ICTs in their classrooms: (a) access to

ICTs, (b) sufficient levels of ICT knowledge, (c) fear of the unknown, and (d) unknown benefits from ICTs.

The National Center for Education Statistics (2000) surveyed 1,847 teachers nationwide and several barriers to integrating technology were reported. Most frequently were insufficient access to computers (78%), lack of release time for technology training and practice (82%), and not enough class time for students to use computers (80%). Teachers also reported that they needed better instructional software (71%), their Internet access had difficulties (58%), and their students had access to inappropriate materials (59%). Over half of teachers surveyed reported inadequate technology equipment (66%), not enough training opportunities (67%), little technical support (64%), and lack of integration support (68%). The barrier that was least likely to be reported was lack of administrative support (43%).

A survey was taken by a random sample of 168 K-12 teachers at four rural Tennessee schools, with several barriers to the use of technology reported (Littrell, Zagumny & Zagumny, 2005). Respondents (43.5%) listed lack of time as their number one barrier to using technology in their classrooms, and it was listed as either the number one or number two barrier by 78.8% of these respondents. Lack of access to equipment (22.6%) and lack of training (16.1%) were also noted.

Teachers are not the only ones who were concerned with the numerous constraints that limited the use of technology in classrooms, but students as well. The national *Speak-Up Survey* (Project Tomorrow, 2009) was completed by 281,000 K-12 students about their technology use in school. Almost half (43%) reported the intrusive use of firewalls that block access to needed websites, and 35% felt teachers limited their technology use. A third of the 3rd-12th grade students reported that not being able to use their mobile devices such as laptops, cell phones and MP3 players was also a significant obstacle.

Technology Professional Development

Over the last ten years, technology has quickly become accessible for teachers to use in their classrooms, but the ability to effectively use it to improve instruction has not occurred. Research has shown that teachers wanted to use technology in instruction, but lacked the experience and the knowledge of how to use it effectively (Bauer & Kenton, 2005; Guerrero, Walker, & Dugdale, 2004). This lack of understanding prevents teachers from experimenting with new technologies and integrating it into their curriculum (Kotrlik & Redmann, 2005). Teachers should be learning how to use technology, but also how technology can be integrated into instruction (Gningue, 2003). Quality professional development is what teachers require as they try to integrate technology into their classrooms (Stolle, 2008).

Professional development that demonstrates quality characteristics has the potential to improve instruction using technology. Participating in technology professional development that exhibits quality characteristics positively influences teachers' teaching practices according to several research studies (Mouza, 2009; Silverstein, Frechtling, & Miyoaka, 2000; SRI International, 2002; Wenglinski, 1998). How much of an influence depends on the quality of the professional development. It was determined in the SRI International (2002) study that the number of professional development activities and the focus on the integration of technology into instruction appeared to have positive influences on how teachers used technology during instruction.

Teachers need to understand not only how to use the technology, but how to integrate it into their curriculum (Dockstader, 1999). The amount of instruction teachers are given to integrate technology in a professional development course can also influence how teachers use technology. In a number of studies, teachers reported they needed more training on how to integrate the technology into instruction rather than basic computer skills (SRI International, 2002; Stolle, 2008).

Technology integration training that teaches technology skills as well as constructivist instructional practices is essential for teachers to understand how to teach curriculum standards using the appropriate tools. In a study by Penuel, Boscardin, Masyn, and Crawford (2007), teachers who received professional development in instructional strategies that were conducive to technology integration used technology more frequently and applied a variety of instructional strategies. Not all technology professional development courses teach participants how to integrate the technology into their instruction. Skill-based technology professional development typically focuses on technical skills and does not focus on instructional practices (Matzen & Edmunds, 2007). As teachers prepare students to apply 21st century skills, they must evaluate how they are providing instruction to digital natives. When professional development focuses on student-centered instructional practices, teachers are more likely to situate technology into a more constructivist environment (Matzen & Edmunds, 2007). Teachers must be trained on how to unite technology, curriculum content, and pedagogy (Pierson, 2001), which is not occurring in most technology professional development courses designed for teachers (Birman, Desimone, Porter, & Garet, 2000).

West Virginia has made considerable efforts to improve the use of technology by its teachers. West Virginia was the second state in the nation to join with the Partnership for 21st Century Skills to support teachers in their efforts to teach 21st century skills (WVDE, 2009). This partnership inspired the recent initiative, Global 21, a plan to prepare teachers to educate students for a 21st century global marketplace (WVDE, n.d.). The Global 21 initiative inspired the development and implementation of an ongoing technology professional development course for K-12 teachers, training of integration specialists to mentor teachers, and the forming of partnerships with professional organizations such as the IntelTeach Program and the Oracle Education Foundation (WVDE, n.d.). An interactive site, Teach 21, was also designed to make available 21st century content standards, and instructional strategies using technology tools for WV teachers (WVDE). In addition, a grant was given by the Verizon Foundation for training teachers to use the online interactive resource site Thinkfinity (WVDE). These efforts, as part of the Global 21 initiative, acknowledge that teachers in WV must understand how to integrate technology using 21st century curriculum standards (WVDE).

Characteristics of Quality Professional Development

Backus' (2005) research on quality professional development formulated six characteristics that represented a quality course. These six characteristics were as follows:

Learning needs. Backus (2005) described the first characteristic of quality professional development as "Targeted staff development — professional growth activities and opportunities that are directly related to the needs of the individual teacher and his/her school environment; based on teacher and/or school needs, activities and experiences that are directly related to a teacher's particular concerns or interests and pertinent to his/her educational environment" (p. 11).

Technology professional development should be structured around technology curriculum standards for teachers. The International Society for Technology in Education (ISTE, 2008) recently updated their standards for teachers designed to measure proficiency and set goals for the knowledge, attitudes, and skills necessary for teaching 21st century skills. The first standard for teachers is to *Facilitate and Inspire Student Learning and Creativity*. Teachers should be inspiring students by creating learning environments that support and promote collaboration, creativity, technology use, and reflection while exploring real-world issues and solving authentic problems using technology. Standard two, *Design and Develop Digital-Age Learning Experiences and Assessments*, is to design, develop, and evaluate authentic learning experiences and assessments using technology to promote creativity, address multiple learning styles, and provide a variety of formative and summative assessments. The third standard, *Model Digital-Age Work and Learning*, is using technology for collaboration, communication, and research, so students are prepared for a global and digital society. The fourth standard, *Promote and Model Digital Citizenship and Responsibility*, is to advocate, model and teach digital information and technology safety and ethical uses while developing and modeling cultural understanding and global awareness. Teachers must use learner-centered strategies to address the diverse needs of all students and provide access for students to use appropriate digital tools and resources depending on their individual needs. The last standard, *Engage in Professional Growth and Leadership*, is to model life-long learning and exhibit leadership in their schools and professional communities by demonstrating technology use and exploring creative uses of technology. The ISTE National Educational Technology Standards for Teachers (NETS-T) identifies how teachers should be using technology, and should guide professional development coordinators in their efforts to create quality professional development.

A strategy that can be used to help teachers apply the ISTE standards in their instruction is modeling. Professional development course instructors that model successful approaches to integrating technology can influence how teachers will use technology in their teaching. In a professional development project, Howland and Wedman (2004) observed that modeling was a valuable instructional support to teachers learning technology. Modeling was instrumental in the Right-Time, Right-Place, Right-Form model that involved having the instructor provide individual technology support and teaching to teachers (Wedman, Laffey, Andrews, Musser, Diggs, & Diel, 1998). This type of assistance gives teachers the necessary backing to request help and provide instruction that develops their technology skills (Wedman, et al.). Modeling can also benefit student teachers who are learning how to integrate technology. In a teacher preservice program in Canada, the students rated their most beneficial course as one that focused on modeling (Francis-Pelton, Farragher, & Riecken, 2000).

Collaboration. Backus (2005) described the second characteristic of quality professional development as "Collaborative staff development — professional growth activities and opportunities that allow teachers to engage in collegial interactions and support to establish sustained learning communities; activities and experiences in which teachers interact with peers and create learning opportunities that establish equal and supportive relationships among developers, presenters, and participants of professional growth experiences" (p.11).

It is beneficial for teachers to have opportunities to interact with their colleagues and share technology integration experiences. Networking and sharing ideas is a key element when encouraging teachers to embrace technology (Burns, 2002). Using collaboration in a technology professional development course can positively change the influence it has on its participants. Professional development that encourages teachers to collaborate with each other typically places more emphasis on content, allowing for more active learning experiences, and provides a more coherent learning environment (Birman, Desimone, Porter, & Garet, 2000).

There are several benefits to using collaboration as a means of assisting teachers in learning technology. Small groups, often identified as collaborative inquiry groups, working together to investigate pedagogical and content issues have emerged as a promising strategy to assist in educating teachers (Crockett, 2002). At a professional development school in California for educators, teachers collaborated in a cohort design where Adams (2005) found that not only were teachers teaching each other ways of integrating technology, but also began using the technology tools learned in courses in their own instruction. Using small collaborative groups offers teachers support for using new technologies and allows opportunities to discuss integration ideas. Collaborative groups present teachers with stronger technology backgrounds chances to help those with weaker backgrounds (Vannatta & Beyerbach, 2000). Collaboration is a critical element in the success of professional development for teachers to share and work together with their peers (Fullan, 1999).

Follow-up. Backus (2005) described the third characteristic of quality professional development as "Sustained, ongoing staff development — professional growth activities and opportunities that reflect a long-term plan that is focused and allows for a continuous form of application; activities and experiences that are conducted in a long-term, sustained manner that allow for continual, follow-up assistance and re-examination beyond the initial professional growth opportunity" (p. 11).

According to a U.S. Department of Education (2000b) survey, teachers who spent more time participating in professional development activities felt more prepared to use technology for instruction than teachers who had less. This poses a problem when the most common form of professional staff development is given to teachers in a short workshop with little to no follow-up activities after the initial training (Gningue, 2003; Parsad, Lewis, & Farris, 2001). Frequently, the professional development experience for teachers learning new technologies is short term and focuses on computer skills, which makes it difficult for teachers to use technology in more constructivist and learner-centered approaches (Matzen & Edmunds, 2007). Traditional forms of professional development do not fit the needs of teachers learning how to integrate technology into their classrooms (Wells, 2007).

Embedded. Backus (2005) described the fourth characteristic of quality professional development as "Time-friendly, job-embedded staff development — professional growth activities and opportunities that are embedded within the teacher's normal working day and are site specific; activities and experiences that are created as one component of the teacher's work schedule during normal school hours and are viewed as an essential part of the teacher's everyday responsibilities" (p. 11-12).

Professional development in technology integration should not stop once the course has ended, for a mentor can provide technology instruction and support during regular school hours. According to the Ministry of Education Standards Department (2002) mentors have three specific roles when working with teachers learning technology integration. First, a mentor is a consultant who encourages independence while providing the teacher with challenges along with the necessary support for them to succeed. Another role of a mentor is as a collaborator who must communicate in the planning, decision, and problem-solving processes with the teacher. The last role is to coach the teacher and help with issues and encourage reflection on experiences.

Recently, mentoring has been successful in facilitating the integration of technology for teachers participating in professional development training (Cole, Simkins, Penuel, 2002; Franklin, Duran, & Kariuki, 2001). In a study on the influence of a mentor to help teachers overcome barriers to integrating technology, it was found that mentors can model effective technology uses that help teachers see how it can be integrated into their teaching (Franklin, Duran, & Kariuki, 2001). This study also found that mentors helped the teachers by providing the necessary technology support for teachers *just in time* when they needed to use the tools in their instruction. In addition, mentors helped teachers design and assess projects that utilized technology effectively. Providing a mentor to participants in a technology professional development course will support teachers in their efforts to integrate technology.

Reflection. Backus (2005) described the fifth characteristic of quality professional development as "Reflective staff development — professional growth activities and opportunities that allow for deep reflection by the participant and developer of staff development experiences as a part of the professional growth activity; activities and experiences that provide time for teachers to analyze their use of knowledge and skills gained through staff development experiences and reflect upon their practice in order to initiate subsequent professional growth opportunities" (p. 12).

There have been several prominent researchers who have identified reflection as a key element in the success of providing quality professional development for teachers. Dewey (1933) was one of the earliest researchers who believed that teachers who critically reflected on their teaching practices would anticipate and prepare for events instead of relying on their usual ideas and impulses. He believed that reflective thinking was one of the three primary sources of knowledge, and it involved dynamic, continual, and thorough contemplations of beliefs or practices. Dewey suggested there were four criteria in the process of reflection:

1. Reflection is a meaning-making process that moves the learner from one experience into the next with deeper understanding of its relationships with and connections to other experiences and ideas.
2. Reflection is a systematic, rigorous, disciplined way of thinking, with its roots in scientific inquiry.
3. Reflection needs to happen in community, in interaction with others.
4. Reflection requires attributes that value the personal and intellectual growth of oneself and others. (Rodgers, 2002, p. 845)

Another researcher, Schon (1987) of the Massachusetts Institute of Technology (MIT), suggested that reflection was a defining characteristic of the writer's professional practice, and it can occur throughout the teaching process. Elaborating on Schon's belief that reflection can happen at any time, Kottkamp (1990) suggested that there are two kinds of reflecting instances that can occur. The first, *reflection-on-action* occurred before the lesson when the teacher was predicting outcomes and after the lesson once it had been taught. The second type of reflection was *reflection-in-action* which occurred during the teaching of the lesson as it was being adjusted and modified by the teacher. Professional development that focused on having teachers reflect before, during, and after their teaching experiences using technology reveals their strengths and weaknesses.

Evaluation. Backus (2005) described the sixth characteristic of quality professional development as "Evaluated staff development — professional growth activities and opportunities that provide an ongoing, systematic evaluation process to determine the effectiveness and impact of staff development on teaching and student learning; activities and experiences that allow for the collection of data throughout each stage of the staff development experience, from the teacher's acquisition of new knowledge and skills, to how the newly gained knowledge and skills affect teaching, to how the changes in teacher practices as a result of newly gained knowledge and skills affect student learning" (p. 12).

The Joint Committee on Standards for Educational Evaluation defined evaluation as the systematic investigation of merit or worth (Gusky, 2002). It is important to know what influence the professional course has on its participants and their students. Gusky suggested that when a professional development course is evaluated there are five critical levels of collecting and analyzing data. Each level must be successfully completed before the next level can begin in the evaluation process. The first level measures the participants reaction to the course and provides data on how to improve the training and perhaps the comfort level of the participants. The second level identifies what the participant learned from the course. The third level evaluates the organization of the course and how effective it was in supporting the learning of the participants. The fourth level assesses the influence the course had on the participant's teaching. Lastly, the fifth level addresses how the students are influenced by the teacher's participation in the course. Each of the five levels of evalution provide the researcher with a thorough account of the professional development's influence on teaching and learning.

CHAPTER THREE: METHODS

This mixed-methods study used both qualitative and quantitative methods to evaluate the influence of a quality professional development course, *Infusing Technology*, on its participants. The *LoTi Digital-Age Survey* was administered to participants to evaluate their levels of technology innovation, personal computer use, and current instructional practices (Appendix G). Additional survey items and focus groups were conducted to determine perceived constraints and enablers to integrating technology into the curriculum.

Research Questions

The following research questions are addressed:

1. How did the *Infusing Technology Institute* affect the teachers' levels of technology innovation?
2. How did the *Infusing Technology Institute* affect the teachers' levels of personal computer use?
3. How did the *Infusing Technology Institute* affect the teachers' levels of current instructional practices?
4. What did the teachers perceive as constraints to implementing the technology as learned from the *Infusing Technology Institute*?
5. What did the teachers perceive as enablers to implementing the technology as learned from the *Infusing Technology Institute*?

Quality Professional Development Course Validation Study

The Quality Professional Development Checklist was used to determine whether or not the *Infusing Technology* course was deemed a quality professional development course. This instrument was not designed to answer any of the research questions, but was administered to a panel of experts based on their technology and/or professional development experience, to validate the quality of the *Infusing Technology Institute*. The checklist was created by the researcher based on Backus' (2005) six characteristics of quality professional development. A cover letter that described the study and provided the respondents with directions was given to each member of the panel of experts in addition to the Quality Professional Development Checklist and Description of the *Infusing Technology* Course. Each of the panel members returned the checklist identifying whether or not each question either did or did not meet the quality professional development criteria. All related documents are included in Appendix H.

The results of this quality professional development course validation were that the *Infusing Technology* professional course was considered quality by the panel of experts**.** Each of the panel members answered "Yes" to all of the quality professional development statements using the description of the *Infusing Technology Institute*.

Research Design

This mixed-methods study used a Quasi-Experimental evaluation for its quantitative data collection. A Quasi-Experimental evaluation cannot prove that a program causes change, but it can provide: (a) descriptive information about the population served, (b) information that suggests whether anticipated changes are occurring, and (c) data that suggest the magnitude of change that is occurring over time (Moore, 2008). The Quasi-Experimental design evaluation, the LoTi Survey, was used to evaluate the *Infusing Technology Institutes'* influences on participants with regard to technology implementation, personal computer use, and instructional strategies. The

LoTi Survey, designed by Moersch, Director and Co-Founder of the National Business Education Alliance, was administered to participants as a pre-assessment prior to receiving training and as a post-assessment after participants have had time to implement content learned from the training.

In addition, focus groups (along with the LoTi survey) were conducted by the researcher to help in understanding perceived constraints and enablers to technology integration. Using focus groups in conjunction with the survey served as a triangulation procedure to confirm findings and expand the researcher's understanding (Brodigan, 1992). Using triangulation as a research technique "…can strengthen the researcher's reason to believe that a particular finding is reliable" (p. 2). Krueger and Casey (2000) suggested that focus groups have the following characteristics:

1. Typically involve 5-10 people
2. Participants have something (important to the research) in common
3. Provide qualitative data that is compared to at least three other focus groups to find range of opinions
4. Have a focused discussion using an interview guide that begins with general open-ended questions and followed by more specific questions

Population

The population for this study was 43 elementary and middle school teachers in West Virginia whose schools were chosen to participate in the *Infusing Technology Institute*. Schools that submitted applications were chosen based on their expressed need and desire to learn more about how to integrate technology into the curriculum (L. Sparks, personal communication, July 22, 2009). Each school had four to six teachers who participated in the Institute as a team. With a total of 43 participants, 21 elementary teachers representing four elementary schools and 22 middle school teachers representing four middle schools participated in this study. Out of the 43 participants, 43 participated in the LoTi Digital-Age pre survey and 35 in the post survey.

Instrumentation

The *LoTi Digital-Age Survey* (Appendix I) was used in this study to examine the levels of technology innovation, personal computer use, and technology instructional strategies of inservice teachers. This survey was used to answer Research Questions 1 through 3. Focus group discussions offered additional supporting detail.

The first part of the survey asked respondents to provide demographic data using 10 questions. Respondents were asked what subject they taught, years of experience, age group, and highest level of education. Respondents were also surveyed about the technology in their classrooms, such as how many computers are available for instructional use and how often students use the computers. The respondents provided data on how many hours of technology-related training they had received over the past five years, who provided them with the most guidance and/or inspiration related to technology integration, and their participation in technology sharing sessions at their schools.

The second part of the survey included 37 questions about how participants are using technology and offered eight response options. The responses had a scale of 0 to 7 with 0 (*Never*), 1 (*At Least Once a Year*), 2 (*At Least Once a Semester*), 3 (*At Least Once a Month*), 4 (*A Few Times a Month*, 5 (*At Least Once a Week)*, 6 (*A Few Times a Week*), and 7 (*At Least Once a Day*). This scale was used for all 37 questions to determine the results for the levels of technology innovation (LoTi), personal computer use (PCU), and current instructional practices (CIP) scores.

Additional survey data along with focus group interviews was designed to answer Research Questions 4 and 5. The participants were asked questions by the researcher to gain an understanding about their perceptions of enablers and constraints to implementing technology and how the Institute influenced their instruction (see Appendix J).

LoTi Validation Study

The *LoTi Digital-Age Survey* is closely aligned to the National Educational Technology Standards (NETS-T) and the Partnership for 21st Century Skills standards (Moersch, 2010), which were the same standards the *Infusing Technology Institute* used to develop and implement the course. In addition, results from the Stoltzfus' (2006) validation study on the *LoTi Digital-Age Survey* closely aligned to the goals of the *Infusing Technology Institute*.

Stoltzfus (2006), from Temple University, conducted an extensive validation study of the LoTi Survey using representative item samplings of the content domains (LoTi Connection, 2009). Stoltzfus indicated that using technology for complex student projects was empirically the highest focus of the study and can be applied in conjunction with Bloom's Taxonomy to support higher-order thinking and problem-solving skills in students. The results showed that the survey contained reliable and valid constructs to prioritize professional development needs such as:

- *using technology for complex student projects requiring problem solving, critical thinking, and real world applicability*

- *teacher proficiency in using technology*
- *student influences on teacher's current instructional practices*
- *dependence on resources and assistance to increase comfort level in using technology*
- *challenges to teacher's use of computers in the classroom* (Stoltzfus, p. 7)

Recommendations, such as reducing the number of questions from 50 to 37 to align with the five empirically-validated constructs identified in the Stoltzfuz (2006) research, shaped the creation of the revised *LoTi Digital-Age Survey*. This instrument was designed to evaluate six different types of personnel: (a) higher education faculty, (b) school administrators, (c) media specialists, (d) instructional specialists, (e) inservice teachers, and (f) preservice teachers.

Data Collection Procedures

In order to collect pre-professional development data, the *LoTi Digital-Age Survey* was provided to the participants on the first day of the *Infusing Technology Institute*. Participants were given a copy of the Anonymous Internet Survey Consent Form (Appendix K), which provided a brief description of the study, survey, and instructions on how to access and take the survey. This form also informed the participant that participation was completely voluntary and any question could be skipped by leaving it blank. The consent form stated that completing the online survey indicated the participants' consent for use of their answers. It also provided contact information for the researcher and Marshall University's Office of Research Integrity.

After reading the consent form, participants who agreed to be a part of the study followed written directions to register and access the online survey using a Group ID and

Password. Registration required participants to provide a User ID, User Password, and an email address needed in order to correlate pre and post results. Participants were assured that this information would not be shared and all responses would be reported in aggregate.

The second form of data collected was the post survey. After participating in the Infusing Technology follow-up training, participants logged into the LoTi Connection website using their User ID and User Password and took the same LoTi Digital Age Survey.

The third form of data collected was the focus group interviews. The interviews were conducted during the second part of the participants' training. The structure of the focus groups included criteria from Kruegar and Casey's (2000) research such as creating groups using teachers from the same schools and/or who taught same subjects, and interviewing at least three groups. Prior to conducting the focus group interviews, each participant read a consent form and signed it agreeing to participate (Appendix L). Interviews were recorded solely for transcription purposes.

Data Analysis Procedures

The LoTi Digital-Age Quick Scoring Device and the *LoTi Digital-Age Survey* Scoring Calculation Key were used to calculate the LoTi, PCU, and CIP scores. These scores were then compared by analyzing the pre/post survey results. In addition, several items from the LoTi survey provided data as to enablers and constraints to technology integration. The pre and post LoTi, PCU, and CIP scores were analyzed by the researcher using the Statistical Package for the Social Sciences (SPSS) using descriptive statistics and the Wilcoxon signed-rank test for non-parametric data. Ancillary findings based on demographic data were reported where significant.

Qualitative data was derived from the focus group interviews. Analysis of the data followed Bogdan and Biklen's (2003) definition of data analysis as a process of systematically searching and arranging the interview transcripts, working with the data, organizing it, breaking it into manageable units, coding, synthesizing, and searching for patterns.

CHAPTER FOUR: FINDINGS

The purpose of this mixed-methods study was to examine whether a quality professional development course, *Infusing Technology*, influenced teachers' integration of technology, their knowledge of digital tools and resources, and instructional practices based on findings from the *LoTi Digital-Age Survey*. Focus group interviews and additional survey items identified technology innovation constraints and enablers.

This study was designed to answer the following research questions:

1. How did the *Infusing Technology Institute* affect the teachers' levels of technology innovation?
2. How did the *Infusing Technology Institute* affect the teachers' levels of personal computer use?
3. How did the *Infusing Technology Institute* affect the teachers' levels of current instructional practices?
4. What did the teachers perceive as constraints to implementing the technology as learned from the *Infusing Technology Institute*?
5. What did the teachers perceive as enablers to implementing the technology as learned from the *Infusing Technology Institute*?

Population and Sample

This study had an initial population of 43 participants who worked as elementary and middle school teachers in West Virginia and applied to participate in the *Infusing Technology Institute*. Teachers were chosen based on their expressed interest in learning more about integrating technology into their curriculum (L. Sparks, personal communication, July 22, 2009). All 43 participants responded to the LoTi Digital-Age pre survey with 35 responding to the post survey. Twenty-three of these participants were also involved in focus group interviews that were conducted during the follow-up *Infusing Technology Institute* that was held seven months after the initial summer training.

Table 10 shows demographic data for both pre (n=43) and post (n=35) survey respondents. The majority of participants were 41-50 years of ages, had a Master's degree, and were experienced teachers with more than 20 years of teaching experience.

Table 10. Demographics of Participants

	Pre		Post	
Variable	*f*	P	*f*	P
	n=42		n=33	
Age Group				
21-30 years of age	9	20.9	7	21.2
31-40 years of age	11	25.6	9	27.3
41-50 years of age	15	34.9	13	39.4
Over 50 years of age	7	16.3	4	12.1
	n=43		n=35	
Degree				
Bachelor's	15	34.9	11	31.4
Master's	28	65.1	23	65.7
Educational Specialist			1	2.9
	n=42		n=35	
Years of Experience				
Less than five	6	14.3	5	14.3
Five to nine	9	21.4	6	17.1
Ten to twenty	11	26.2	10	28.6
More than twenty	16	38.1	14	40.0

Major Findings

A Quasi-Experimental, pre and post evaluation method was used to identify how the professional development affected the participants' levels of technology innovation (LoTi), personal computer use (PCU), and current instructional practices (CIP) using the survey. There were 37 survey questions that provided eight response options ranging from *never* to *at least once a day* and ten additional demographic questions. Focus groups were conducted to triangulate the data received and provide confirmation and explanation of the results.

Levels of Technology Innovation

The levels of technology innovation (LoTi) survey questions measured the implementation of digital-age literacy based on the National Educational Technology Standards for Teachers (NETS-T). Participants' uses of digital tools and resources to promote higher order thinking, student engagement, and authentic assessment practices were evaluated using the LoTi Digital-Age Quick Scoring Device and calculated using the *LoTi Digital-Age Survey* Scoring Calculation Key. There were 22 questions in the *LoTi Digital-Age Survey* that were used to determine the LoTi.

Research Question #1. How did the *Infusing Technology Institute* affect the teachers' levels of technology innovation? Based on the evaluation of the *LoTi Digital-Age Survey*, the *Infusing Technology Institute* did not appear to significantly affect the participants' levels of technology innovation. Analysis of qualitative data from focus group interviews supported these conclusions based on the emerging themes of (a) limited success in reaching the *transforming uses* level, (b) confusion over *transforming uses* process, (c) lack of confidence in ability to create and implement *transforming uses* lessons, (d) lack of time, (e) acknowledgement of importance to reach *transforming uses* level, and (f) developmental readiness of students to complete *transforming uses* projects.

Descriptive Statistics. The number of participants who scored at each LoTi level on the pre and post survey is shown in Table 11. The majority of participants scored within LoTi Intensity Level Two for both the pre (*f*=23, P= 53.5) with *f* standing for frequency and P standing for percentage, and post (*f*=16, P=37.2) survey. Level Two, Exploration, identifies instruction that emphasizes content understanding and supports mastery learning and direct instruction with students using lower level cognitive processing skills. At this level, digital tools and resources are used for extension activities, enrichment, and student presentations. Further analysis reveals minimum scores at Level 1, Awareness, on both pre and post surveys with maximum scores increasing from Level 5, Expansion, on the pre survey to Level 6, Refinement, on the post survey.

Table 11. Frequencies of LoTi Levels

		Pre		Post	
	LoTi Levels	*f*	P	*f*	P
		n=43		n=35	
0	Nonuse				
1	Awareness	10	23.3	6	14.0
2	Exploration	23	53.5	16	37.2
3	Infusion	2	4.7	8	18.6
4a	Integration: Mechanical	3	7.0	1	2.3
4b	Integration: Routine	4	9.3		
5	Expansion	1	2.3	3	7.0
6	Refinement			1	2.3

Two-related Samples Wilcoxon Matched-pairs Signed-rank Test. The two-related samples Wilcoxon matched pairs signed-rank test was used to determine if there was a significant difference between the pre and post LoTi Intensity Levels. The hypotheses were:

1. Null hypothesis: There is not a significant difference between the pre and post levels of technology innovation (LoTi) of teachers who participated in the *Infusing Technology Institute*.

2. Alternate hypothesis: There is a significant difference between pre and post levels of technology innovation (LoTi) of teachers who participated in the *Infusing Technology Institute*.

Table 12 shows the frequency of negative (10), positive (14), and tied (11) ranks indicating that the greatest number of participants (14) did increase their levels of technology innovation.

Table 12. Wilcoxon Signed-Ranks Test Statistic: Pre/Post LoTi Levels

Ranks	*f*	Mean Rank	Sum of Ranks
Negative Ranks	10[a]	11.75	117.50
Positive Ranks	14[b]	13.04	182.50
Ties	11[c]		
Total	35		

a=PostLoTi<PreLoTi, b=PostLoTi>PreLoTi, c=PostLo-Ti=PreLoTi

However, the difference in pre and post LoTi was not statistically significant (z= -.957, p= .338), as shown in Table 13. Therefore, the null hypothesis was accepted. There was not a significant difference between the pre and post levels of technology innovation (LoTi) of teachers who participated in the *Infusing Technology Institute*.

Table 13. Test Statistic[b]: Pre/Post LoTi Levels

Statistic	Pre LoTi- Post LoTi
Z	-.957[a]
Asymp Sig. (2 Tailed)	.338

a. Based on negative ranks, b. Wilcoxon signed-ranks test

Focus Group Interview Findings. During focus group interviews, several participants commented about their struggles reaching higher levels of technology integration, in particular the *transforming uses* level of the Grappling's Technology and Learning Spectrum. The three levels of Grappling's, *literacy uses, adapting uses,* and *transforming uses* were introduced to participants during the initial *Infusing Technology*

Institute and reviewed during the follow-up session. Each level categorizes technology instruction:

1. *Literacy uses*- teaching students how to use the technology
2. *Adapting uses*- technology used as a support for traditional tasks and assessments
3. *Transforming uses*- technology used to teach essential learning skills such as complex learning and thinking (see Appendix F).

While some participants were successfully reaching the *transforming uses* level of technology integration, others, who acknowledged the importance of reaching higher levels of innovation, expressed confusion about the process and a general lack of confidence in their own ability to create and implement lessons at this level. Many participants voiced concern about the developmental readiness of students to complete *transforming uses* projects and the need for more time to implement lessons at this level.

A few focus groups discussed their success creating and implementing *transforming uses* activities and identified how the process had influenced technology integration in their classrooms. This middle school group explains:

Participant 3: I think this right here.

Interviewer: Grappling's?

Participant 3: Yeah, showing us how, when we do use technology, how to take it to the highest level. For me, that's what has been the most helpful. Because when I look back, I've used technology a lot, but the way that I used it wasn't the best way to use it. I've always, for some reason, stuck right here [points to *adapting uses* on the chart]. I think, just from what we've gained from here [the *Institute*]; I've been able to grasp how to use/ move those things over to here [points to *transforming*] to a higher level.

Interviewer: Have you been able to do that this year?

Participant 3: I think so.

Interviewer: Give me examples of something that you've done that you've been able to change [towards *transforming*].

Participant 3: Well, just like the one we were talking about here [at *Institute*]. I've got a ThinkFinity lesson on nutrition that we had identified as *adaptive* and moving it over to *transforming* [turns to another teacher]. I'll let you explain it, I can't think of what I'm trying to say now.

Participant 4: Well, like previously, we would have just taught the lesson on nutrition and given them the background information, but now we realize how important it is for them to take that information and create something else. Because they're going to be doing the research, they have the background information, and then we want them to be able to take that information and create a project. Identify the problem, make a recommendation and basically create a public service announcement. I think that just finding out that instead of just teaching the lesson with technology or just having the students do something to teach like, "Here's how you save a file". To actually combine the two, basically, and have them come up with something where they're creating something unique and of their own I think.

Several focus groups indicated they were unclear how to implement a *transforming uses* activity, but after the follow-up session they had a better understanding. In this group, a participant shared her original misconceptions about what a *transforming uses* activity was and expressed her inability to adapt lessons to make them more transformative.

Participant: We made them research an explorer as part of our social studies. They figured out what was important information, they made the slides, put the notes on the bottom and all of that. And they had to stand up and orally present using their PowerPoint with their partner; to teach the information about those explorers to the other kids. So that, I thought was moving towards *transforming*, but it's not quite *transforming*. I mean they are working together, the cooperative learning, they're basically using the PowerPoint to assist them in presenting the material that they would have done just standing up and talking about it. I don't know how to make mine more *transforming*.

Several other participants also indicated that teaching with *transforming* lessons was not something they had been able to accomplish yet and acknowledged the importance of integrating more *transforming* lessons.

Participant 1: I haven't done anything *transforming*.

Participant 2: I don't think I have either. I do know that I do need to try to lean more towards *transforming*. So, that is going to be constantly on my mind. It's just like they were talking about, [*Infusing Technology* presenters] you need to just take your assignments to another level.

More than one group was concerned about their ability to create a *transforming uses* lesson and expressed a need for more time to reach this level of technology integration. Like other groups of elementary teachers, this group indicated their elementary students were not capable of evaluating and synthesizing information, which is a component of a quality *transforming uses* lesson.

Participant 1: Here's the problem I have, and I've written it on the Wiki [The *Infusing Technology* Wiki]. I know what *transforming* is, but I don't know how to get from adapting to *transforming*.

Participant 2: We can't get there. The problem is in Elementary [*sic*]. *Transforming* is creating the content. We have very specific [*sic*]. It's not like [*sic*].

Participant 3: And we have certain time constraints. I mean a project like this [*sic*]. They would need the whole morning to do that. I could never get to do that.

Participant 1: And we have to stay after school

Participant 4: The bad thing about what we have learned in college about how their minds develop [*sic*]. They haven't developed some of the stuff [*sic*].

Participant 1: Developmentally they're not ready for some of this.

Participant 2: I don't think developmentally *I'm* [italics added] ready for some of it.

Participant 1: I'm with you.

Participant 4: Because it requires a lot of examination and synthesis.

Significance Based on Demographics: Kruskal Wallis Test of Independent Groups. The Kruskal Wallis test of independent groups was used to determine if there were differences among groups between the participants' post LoTi Intensity Levels and participant demographics. Based on the Kruskal Wallis test results, there were no significant findings between the participants' LoTi Intensity Levels and the following demographic groups: (a) years of teaching experience, (b) age, (c) level of education, (d) number of computers in classroom, (e) how often students use computers, (f) greatest obstacle to technology integration, (g) teacher use of digital tools and resources, and (h) student use of digital tools and resources used.

Personal Computer Use

The Personal Computer Use (PCU) survey questions measured participants' fluency levels with using digital tools and resources for student learning. Participants' uses of emerging digital tools in the classroom were evaluated using the LoTi Digital-Age Quick Scoring Device and calculated using the *LoTi Digital-Age Survey* Scoring Calculation Key. Five questions on the *LoTi Digital-Age Survey* were used to determine PCU.

Research Question #2. How did the *Infusing Technology Institute* affect the teachers' levels of personal computer use? The *Infusing Technology Institute* did appear to significantly increase participants' personal computer use based on evaluation of the *LoTi Digital-Age Survey* results. Analysis of qualitative data from focus group interviews supported these conclusions and identified (a) an increase in participants' use of a variety of technology tools introduced and supplied by the *Infusing Technology Institute*, (b) a greater confidence in participants' use of technology with students.

Descriptive Statistics. The number of participants who scored at each PCU level on the pre and post survey is shown in Table 14. The majority of participants scored within pre PCU Intensity Level Two (*f*=11, P= 25.6) and post PCU Intensity Level Four (*f*= 12, P=34.3). Level Two, Not True of Me Now, identifies participants who have little to moderate fluency with using digital tools and resources for student learning. At this level, participants are not confident or comfortable using existing and emerging digital tools beyond classroom management tasks. Level Four, Somewhat True of Me Now, identifies participants who have a moderate to high fluency with using digital tools and resources for student learning. Participants will commonly use a broader range of digital-age media and formats in support of their curriculum and instructional strategies. Further analysis reveals that minimum scores improved from Level 0, Not True of Me Now, on the pre survey to Level 1, Not True of Me Now, on the post survey. The maximum scores were at Level 7, Very True of Me Now, for both pre and post survey respondents.

Table 14. Frequencies of PCU Levels

		Pre		Post	
	PCU Levels	*f*	P	*f*	P
		n=43		n=35	
0	Not True of Me Now	3	7.0		
1	Not True of Me Now	9	20.9	1	2.9
2	Not True of Me Now	11	25.6	4	11.4
3	Somewhat True of Me Now	8	18.6	9	25.7
4	Somewhat True of Me Now	5	11.6	12	34.3
5	Somewhat True of Me Now	6	14.0	5	14.3
6	Very True of Me Now			3	8.6
7	Very True of Me Now	1	2.3	1	2.9

Two-related Samples Wilcoxon Matched-pairs Signed-rank Test. The two-related samples Wilcoxon matched pairs signed-rank test was used to determine if there was a significant difference between the pre and post PCU Intensity Levels. The hypotheses were:

1. Null hypothesis: There is not a significant difference between the pre and post levels of Personal Computer Use (PCU) of teachers who participated in the *Infusing Technology Institute*.
2. Alternate hypothesis: There is a significant difference between pre and post levels of Personal Computer Use (PCU) of teachers who participated in the *Infusing Technology Institute*.

Table 15 shows the frequency of negative (5), positive (19) and tied (11) ranks indicating that the greatest number of participants (19) did increase their Personal Computer Use.

Table 15. Wilcoxon Signed-Ranks Test Statistic: Pre/Post PCU Levels

Ranks	***F***	**Mean Rank**	**Sum of Ranks**
Negative Ranks	5[a]	7.90	39.5
Positive Ranks	19[b]	13.71	260.5
Ties	11[c]		
Total	35		

a=PostPCU<PrePCU, b=PostPCU>PrePCU, c=PostPCU=PrePCU

The difference in pre and post PCU was statistically significant (z= -.3.194, p= .001), as shown in Table 16. Therefore the null hypothesis was rejected. There was a significant difference between the pre and post levels of Personal Computer Use (PCU) of teachers who participated in the Infusing Technology Institute.

Table 16. Test Statistic[b]: Pre/Post PCU Levels

Statistic	Pre PCU- Post PCU
Z	-.3.194[a]
Asymp Sig. (2 Tailed)	.001*

a=Based on negative ranks, b=Wilcoxon signed-ranks test, *p<.05

Focus Group Interview Findings. During focus group interviews, teachers reported increased use of technology or using new technology learned from the *Infusing Technology Institute* including:

- Thinkfinity
- Flip Video Camcorder™ (Flip cam)
- Mimio®
- Smart Board™
- InterWrite Airliner™
- Adobe® Premiere®
- Windows® Movie Maker
- Elmo® Document Camera
- Skype®
- Microsoft® Photostory
- Digital Juice VideoTraxx™
- TurningPoint™ Student Response Systems (clickers)
- Wiki

This increase in technology use was a catalyst, as indicated by many participants, in building their confidence to use technology more with students. For example, the following participants talked about an increase in comfort level as well as an increase in their technology use as a result of the *Infusing Technology Institute*:

Participant 1: It makes me more comfortable with the technology. The Smart Board [sic] I'm not afraid to go on there and search something and bring the kids up and do it. Sometimes it works really well and sometimes it doesn't.

Participant 2: Before all this [*Institute* training], I didn't use a lot of technology in my classroom, and I wasn't comfortable using it in my classroom. I didn't have access to an Intelliboard™ or Smart Board™ until this year when, actually, somebody handed it down because they got an Airliner™. They got that, so they passed their Intelliboard™ down to me. I wasn't comfortable using it until I was able to play with it and now I use it… This [*Institute*] made me, like she said, a little bit more comfortable using it in my classroom.

Participant 3: The more you use it, the more comfortable you get, so it [the *Institute*] has increased my usage and just being comfortable with it. My Smart Board™, using the different sites that we get for games, and I've developed a couple of games on the Interactive Whiteboard to use Thinkfinity [sic].

The funds provided by the *Infusing Technology Institute* enabled participants to purchase needed technology hardware and software. One group of participants indicated an increase of technology use once they received the necessary technology:

Participant 1: We didn't use technology because we didn't have any. The biggest piece of technology we had was an overhead projector.

Participant 2: Being able to purchase items for our classrooms; it makes a huge difference.

Participant 3: There was no technology money available to be able to do anything.

Participant 1: We purchased Mimios®, projectors, Elmos®, and responders.

Significance Based on Demographics: Kruskal Wallis Test of Independent Groups. The Kruskal Wallis test of independent groups was used to determine if there were differences among groups between the participants' post PCU Intensity Levels and participant demographics. Based on the Kruskal Wallis test results, there were no significant findings between the participants' PCU Intensity Levels and demographic questions.

Current Instructional Practices

The Current Instructional Practices (CIP) survey questions measured the instructional practices relating to a subject-matter versus a learner-based approach in the classroom. Participants' uses of instructional strategies that align with student-directed learning, varied assessment strategies, authentic problem-solving opportunities, differentiated instruction, and complex classroom routines were evaluated using the LoTi Digital-Age Quick Scoring Device and calculated using the *LoTi Digital-Age Survey* Scoring Calculation Key. Five questions on the *LoTi Digital-Age Survey* were used to determine CIP.

Research Question #3. How did the *Infusing Technology Institute* affect the teachers' levels of current instructional practices? The *Infusing Technology Institute* did appear to significantly increase participants' current instructional practices based on the evaluation of the *LoTi Digital-Age Survey* results. Qualitative data from focus group interviews of participants provided examples to support changes in instructional practices such as: (a) using less direct instruction and more student centered approaches, (b) using constructivist principles and technology to support problem based learning, cooperative learning, and encourage exploration, and (c) encouraging students to provide peer support using technology.

Descriptive Statistics. The number of participants who scored at each CIP level on the pre and post survey is shown in Table 17. The majority of participants scored within pre CIP Intensity Level Four (*f*=11, P= 25.6) and post CIP Intensity Level Three (f= 12, P=34.3). Level Four, Somewhat True of Me Now, identifies participants who are comfortable supporting or implementing either a subject-matter or learning-based approach to instruction. At this level, students are encouraged to contribute to assessment processes when appropriate, and there is a moderate level of differentiated instruction. Level Three, Somewhat True of Me Now, supports a more subject-matter based approach to teaching and learning with opportunities for student-directed projects that offer differentiated instructional opportunities. At this level, assessment focuses more on traditional measures. Further analysis revealed a shift away from the lower Intensity Levels. For example, minimum scores were at Level 1, Not True of Me Now, on the pre survey and increased to Level 2, Not True of Me Now, on the post survey. In addition, maximum scores increased from Level 6, Very True of Me Now, on the pre survey to Level 7, Very True of Me Now, on the post survey.

Table 17. Frequencies of CIP Levels

	CIP Levels	Pre *f*	Pre P	Post *f*	Post P
		n=43		n=35	
0	Not True of Me Now				
1	Not True of Me Now	3	7.0		
2	Not True of Me Now	9	20.9	3	8.6
3	Somewhat True of Me Now	9	20.9	12	34.3
4	Somewhat True of Me Now	11	25.6	9	25.7
5	Somewhat True of Me Now	10	23.3	9	25.7
6	Very True of Me Now	1	2.3		
7	Very True of Me Now			2	5.7

Two-related Samples Wilcoxon Matched-pairs Signed-rank Test. The two-related samples Wilcoxon matched pairs signed-rank test was used to determine if there was a significant difference between the pre and post CIP Intensity Levels. The hypotheses were:

1. Null hypothesis: There is not a significant difference between the pre and post levels of Current Instructional Practices (CIP) of teachers who participated in the *Infusing Technology Institute*.
2. Alternate hypothesis: There is a significant different between pre and post levels of Current Instructional Practices (CIP) of teachers who participated in the *Infusing Technology Institute*.

Table 18 shows the frequency of negative (6), positive (16) and tied (13) ranks indicating that the greatest number of participants (16) did increase their Current Instructional Practices.

Table 18. Wilcoxon Signed-Ranks Test Statistic: Pre/Post CIP Levels

Ranks	***f***	**Mean Rank**	**Sum of Ranks**
Negative Ranks	6[a]	8.75	52.50
Positive Ranks	16[b]	12.53	200.50
Ties	13[c]		
Total	35		

a=PostCIP<PreCIP, b=PostCIP>PreCIP, c=PostCIP=PreCIP

The difference in pre and post CIP was statistically significant (z= -2.477, p= .013), as shown in Table 19. Therefore the null hypothesis was rejected. There was a significant difference between the pre and post levels of Current Instructional Practices (CIP) of teachers who participated in the *Infusing Technology Institute*.

Table 19. Test Statistic[b]: Pre/Post CIP Levels

Statistic	Pre CIP- Post CIP
Z	-.2.477[a]
Asymp Sig. (2 Tailed)	.013*

a=Based on negative ranks, b=Wilcoxon signed-ranks test, *p<.05

Focus Group Interview Findings. During focus group interviews, participants discussed their instructional strategies based on constructivist principles, such as problem based learning and cooperative learning, using technology. Teachers presented students with more opportunities for additional participation and collaboration with peers and encouraged exploration rather than direct instruction.

For example, a participant in one group described a social studies class project that used the Flip Video Camcorder ™ that was provided as part of the *Infusing Technology Institute*.

Participant: I used my Flipcam to videotape a mock trial that another teacher and I collaborated on, and we’re actually submitting our transcripts for our mock trial for a state competition. And the winner of the state competition gets to perform a mock trial for the state supreme court. We had to do [record] it in front of the magistrate; perform in front of the magistrate. And then we brought it [the recording] back and let the kids watch themselves, so that we could make changes or whatever to our script. And then they could actually see [themselves]. Because we rehearsed it so long, the kids got tired of it, and then they actually saw what they were doing wrong as they watched it.

Another participant in the group described how students in a satellite based Spanish course were using the Internet communication tool, Skype®, when asked about how the *Infusing Technology Institute* influenced instruction. Skype® is an Internet-based synchronous communication tool that was explored during the *Infusing Technology Institute*:

Participant: The Skype® that I learned here; I facilitate a Spanish class and now we Skype® almost every week. It has added a whole level that they have not done before. Because before we used the UFO phone with the three polycom thing and all you could do is hear the kids. Now it has added that whole level dimension, so that when my kids get up and talk to her and stand up in front of the thing, she can see them. She'll even say, "What are you writing." Because he is writing, and had it not been for the Skype® she couldn't see them. So, we're Skyping almost every week with the Spanish facilitator, and that's brand new. And what I can do, is I Flipcam the kids doing stuff, and then I can send it to her because she is a

Spanish teacher and I'm just the facilitator. So, I Flipcam them doing stuff and then I send it to her.

In a middle school focus group, participants described how they allowed students to explore new technology first, rather than providing direct instruction to introduce its features. These teachers also encouraged students with technology expertise to assist peers:

Participant 1: I've done them [PowerPoint] before with them, but this year I did it differently. I took a day and said open it up, now play with it. Before I would have said, now find this icon we're going to put in words. I would have gone step by-step and pulled my hair out by the end of the day. I just let them play. I gave them an entire class period to just play.

Interviewer: And that worked out well?

Participant 1: Yes, for all of us. The good thing about it too is, "How'd you do that?" so they're teaching each other. Then I say "Hey, how'd you do that?"

Participant 2: Sometimes when they learn themselves, they learn more than when we tell them here it is and here is what to do. It's like "Click here and click there."

Participant 1: Because they know that we're going to say it six more times, so "I'm not going to listen for the first five, I'll pick her up on the sixth time." I think that was part of it too, it was like "Wow, she's not telling us anything, so I really do have to figure this out."

Participant 2: I tried to be less of a control freak in the classroom. And let them do the activities without me putting a lot of the input into it. And that was huge for me because I don't usually let them try to figure it out themselves.

Participant 3: I let the kids teach themselves because I did not feel comfortable with the program, so I just let them teach themselves, and it worked out great because the kid leaders rose to the top and they took over. And a kid would ask a question and I would say," Have you asked Andy." And they'll go "Andy, I have a question." And he would come over and answer because I didn't have to.

Significance Based on Demographics: Kruskal Wallis Test of Independent Groups. The Kruskal Wallis test of independent groups was used to determine if there were differences among groups between the participants' post CIP Intensity Levels and participant demographics.

There was one significant difference among groups between post CIP scores and demographics; individuals who provided technology inspiration and/or direction. Participants who identified students and other (e.g. building administrator, college professor, or vendor) as their primary guidance, information, inspiration, and/or direction relating to the innovation of technology in their classrooms scored in the higher CIP Intensity Levels based on the mean rank scores, as shown in Table 20. Unfortunately, this significant distribution may not be generalized due to small cell sizes (students=1; other= 3).

Table 20. Technology Guidance and Post CIP Scores

Post Technology Guidance	*F*	Mean Rank
	n=35	
Classroom teachers	24	17.04
School district specialists	7	14.21
Students	1	34.50
Other	3	29.00

Using the Kruskal-Wallis Test of Independent Groups, Table 21 shows the significance (p=.050) of data distribution.

Table 21. Test Statistic[a]: Technology Guidance and Post CIP Levels

Statistic	Post Tech. Guidance and CIP Score
Chi-square	7.795
Df	3
Asymp Sig.	.050*

a. Kruskal Wallis Test, * $p \leq .05$

Technology Innovation Constraints

Research Question #4. What did the teachers perceive as constraints to implementing the technology as learned from the *Infusing Technology Institute*? Participants identified constraints in the LoTi survey and focus group interviews, such as: (a) a lack of time to learn, practice, plan, and use technology with students, (b) lack of sufficient technology assistance, (c) equipment failure, (d) access to technology, (e) lack of technology knowledge or expertise for substitute teachers, and (f) other priorities (e.g., statewide testing, new textbook adoptions).

Descriptive Statistics. Constraints were identified from the *LoTi Digital-Age Survey* when participants were asked to select from the following list of potential obstacles, as shown in Table 22: (a) access to technology, (b) other priorities (e.g., statewide testing, new textbook adoptions), and (c) time to learn, practice, and plan. The majority of participants identified *time to learn, practice, and plan* as their greatest obstacle on both pre (*f*=23, P= 53.5) and post (*f*=18, P=41.9). Fewer participants viewed *access to technology* as an obstacle when post (*f*=8, P=18.6) results were compared with pre (*f*=16, P=37.2) responses. Some participants also identified *other priorities*, with a greater number identifying this as an obstacle on the post survey (*f*=9, P= 20.9) when compared to pre (*f*=*4*, P=9.3) results.

Table 22. Pre and Post Greatest Obstacle

	Pre		Post	
Technology Constraints	*f*	P	*f*	P
	n=43		n=35	
Access to technology	16	37.2	8	18.6
Other priorities (e.g., statewide testing, new textbook adoptions)	4	9.3	9	20.9
Time to learn, practice, and plan	23	53.5	18	41.9

Focus Group Interview Findings. Participants were given further opportunities to identify constraints to the successful integration of technology during focus group interviews. Similar to the LoTi survey results, participants identified a lack of time to learn new technology and time to prepare for its use as the greatest constraint to using technology. Problems such as lack of technology assistance available, equipment failure, and access to classroom technology, computer labs, and Internet sites were also frequently mentioned. The lack of technology knowledge and expertise that substitutes had was also discussed.

Time. Participants from several focus groups identified time as a major constraint that prevented them from using technology more often in their classrooms. The following exchange specifically highlights a lack of time to learn new technology tools and a lack of time to practice using technology. Access to technology was also mentioned as a factor:

Participant 1: Time would be the biggest one. For me, time.

Participant 2: Right now it is time.

Participant 3: Time.

Participant 4: Maybe this summer we can spend the summer working on stuff.

Participant 5: Wouldn't that be nice. We had a two hour session on how to use responders, and we're supposed to go back to our room and practically use them.

Participant 6: Time, time, time. And learning technology, the software stuff like that.

Participant 7: And that's what it takes, the time to sit down and practice.

Participant 8: That's what I put on that survey. That was the biggest barrier for me.

Participant 9: I did too.

Participant 10: So did I, and not actually having the technology.

A group of middle school teachers discussed the lack of time from a different perspective. Due to extreme winter weather conditions during the 2009-2010 school year, there were an extraordinary number of school closings. These closings were making it difficult for teachers to effectively integrate technology with their content standards to create and implement successful lessons.

Participant 1: You see, we're getting a little bit leery about it because you know we've missed 17 days of school and we've, I've, still got math content to teach. This thing is due May something or other [PSA requirement for *Institute*]. And, you know, I'm a little bit leery. I'm afraid we're going to speed things up and go too fast.

Participant 2: Yeah, it's not going to be as nice of a final product.

Interviewer: So, do you think that has been the biggest barrier, as far as using it, [technology] time, because of school they've missed?

Participant 2: Yup.

Assistance. Teachers also indicated there was a lack of sufficient technology support at their schools, which prevented them from receiving the necessary guidance and support. When asked who supported them in their efforts to integrate technology, two participants explained their frustrations about not receiving support from the county Technology Integration Specialist:

Participant 1: Just me baby, just me. And when I'm the most knowledgeable person there; yeah, that's scary.

Institute presenter: Do you guys have a TIS [Technology Integration Specialist]?

Participant 1: Nope

Participant 2: They have them at the county's Title I schools. Our [TIS] are all at our Title I schools in our county. We have one county guy and he's got the whole eastern end of the county; 13 schools. He was at our school one time.

Another participant described how the teacher who was responsible for providing technology support at her elementary school was not accommodating to her requests for assistance:

Participant: Mindy is our gal, but she's downstairs and she does first grade and she gets real ticked off at you. She's our technology person.

Interviewer: She's a teacher?

Participant: Yeah, She's in this class. But she gets real ticked if we tell her anything's wrong with something. She's told me two or three times that if I do this and this and this and this [sic]; instead of going this way, I'll go this way. Well, you know, I've done it a couple of times, and I used half my planning period a couple of times. And I'm at the point, now, where I'm not making the money being a technologist and she is.

Interviewer: Is that who you usually go to if you have a problem?

Participant: We have to; there's nobody else.

Several other elementary teachers indicated their school technology support teachers were not available when they needed assistance:

Participant 1: Our tech person is our music teacher, who is here, and he is busy teaching music, and we don't have access to him a lot. And he teaches some classes in the computer lab, and if we are having trouble with something [sic]. For example, my laptop crashed that went with my Intelliboard™, and we had a county person come in and he couldn't fix it, and a state person had to come in. It took about 3-4 weeks to fix.

Participant 2: That's true, you are at their mercy.

Interviewer: Did you say your tech person is your music teacher?

Participant 1: He comes in if there's a computer issue. He gets paid extra to try to help us.

Participant 2: Our librarian does too. She's that [tech support].

Participant 1: A lot of the time he is busy. He has computers in the computer lab that he has to fix. You're kind of at their mercy. That's frustrating too because you want to be up and running all of the time.

Several participants discussed the amount of time wasted as they searched for someone to assist them with technology issues. A group of middle school teachers discussed their efforts in searching for technology assistance, and the importance of a full time technology support specialist available at each school:

Participant 1: Hopefully someone knows how, that's another thing; you spend more time going around trying to find someone who can help you. And finally you say "Just forget it."

Participant 2: Well there is, there are some times when you can't get it working.

Participant 3: We almost need a full time sysop in every building. I mean ours is just a supplemental [technology support person].

Participant 4: I am the sysop and sometimes I ask myself [laughs]. Sometimes there's no answer.

Participant 3: They really need a full-time person.

Participant 2: Ours is our music teacher, and if he's in class [sic].

Participant 3: If they're going to implement all this technology, eventually, they're going to have to have a full-time person.

Participant 4: Absolutely.

Participant 1: Everyday.

Participant 2: Just for technology.

The lack of substitutes' technology skills and expertise was also noted by one participant who indicated substitute teachers were not able to use the technology needed for instruction:

Participant 1: We are so used to using the technology especially with the Smart Board™ that when we have a substitute it's hard to pull back to what we used to do; getting out old transparencies when we are just used to pulling it up [on data projector], because they [subs] don't know how to use the technology. Like today, I wrote on my lesson plan book to refer to a child. "Please ask John, he'll hook the Elmo® up for you."

Equipment Failure. Many participants identified equipment failure as a common barrier to technology implementation. One group of elementary teachers expressed concern over technology equipment not working properly and identified the need for flexibility and alternative lesson plans.

Participant 1: Usual technology things; when things decide not to work.

Participant 2: At inopportune moments.

Participant 3: At times you don't want, and you have to redirect what you were going to do because you don't have time to sit there with 20 kids.

Participant 4: And when it doesn't work, here you have 20 six-year olds that have ants in their pants already. And if it doesn't work [sic.] Like they [*Institute* presenters] said earlier "Oh, don't get flustered", but you know you have those kids sitting there looking at you, and you're depending on this lesson, and you have to have an alternative for that day.

Participant 5: And you've told them [already] what you're going to do.

Participant 4: And you have to find a different way [of doing the activity].

Participant 5: You have to be flexible.

Participant 4: Yes, very flexible.

Access. Teachers indicated that access to classroom technology, access to computer labs, and Internet restrictions were also barriers to technology implementation. In one group, two elementary teachers indicated that having to share technology tools also posed a problem when trying to integrate technology:

Participant 1: Oh, I love the Elmo®.

Participant 2: We only had one in our school that we had access to. That's a problem.

Participant 1: That's a pain.

Participant 2: We had one like just in first grade and shared one last year, but there were three first grades. And that was a pain. So we finally got one.

Having access to a classroom set of computers was also identified as a constraint by several participants. Two elementary related arts teachers indicated the lack of an available computer lab was a barrier to technology innovation:

Participant 1: Computer availability.

Interviewer: Do you have a computer lab?

Participant 1: Yeah

Interviewer: Is it just hard to get in?

Participant 1: Yeah, it's hard to get in, especially when all of these other core teachers are doing techSteps™, and all of their computer training kind of shoves me out to the side.

Participant 2: I am right next to the computer lab, but they're usually being used.

Having restricted access to the Internet was discussed by one middle school teacher as a constraint, for filters blocked websites that could be beneficial for instruction.

Participant: For instance, YouTube. I can't bring anything up at school because it's denied. But I can go home and download it on Real Player, and then use it at school, so I've done that. Amanda told me how to do that [another teacher at the *Institute*]… Yeah, because then I can still do it. I can bring it to school, and use it, and play it, and show it… Access denied; that's an issue. But I've kind of worked through it…. the county blocks stuff from the students. So that was a huge issue at first. You can't even show something from like TeacherTube. You're not trying to show anything bad. You can't even show something worthwhile because it's blocked. It wasn't blocked before; they've just done this within the last year….

Technology Innovation Enablers

Research Question #5. What did the teachers perceive as enablers to implementing the technology as learned from the *Infusing Technology Institute*? Participants identified enablers in the *LoTi Digital-Age Survey* and focus group interviews, such as: (a) technology support from other classroom teachers, computer teachers, and school district specialists, (b) technology support from *Infusing Technology* mentors and presenters, (c) funding for new technology tools, and (d) motivation to use technology from administration endorsement.

Descriptive Statistics. The *LoTi Digital-Age Survey* asked participants, as noted in Table 23, to identify who they sought out for primary guidance, information, inspiration, and/or direction relating to technology innovation: (a) classroom teachers, (b) school district specialists, (c) students, and (d) other (e.g., building administrator, college professor, and vendor). The greatest number of participants identified classroom teachers both pre (f=22, P=51.2) and post (*f*=24, P=68.6). Fewer participants identified school district specialists when post (f=7, P=20) results were compared to pre (*f*=18, P=41.9). Only a few participants selected students on both pre (*f*=2, P=4.7) and post (*f*=1, P=2.9), and a small number chose other (e.g., building administrator, college professor, or vendor) on both pre (*f*=1, P=2.3) and post (*f*=3, P=8.6).

Table 23. Pre and Post Guidance

	Pre		Post	
Guidance	*f*	P	*f*	P
	n=43		n=35	
Classroom teachers	22	51.2	24	68.6
School district specialists	18	41.9	7	20.0
Students	2	4.7	1	2.9
Other (e.g., Building Administrator, College Professor, Vendor)	1	2.3	3	8.6

Focus Group Interview Findings. During focus group interviews, participants were given further opportunities to identify enablers to the successful integration of technology. Similar to the LoTi survey, participants identified classroom teachers as their primary source of technology guidance and support, but also identified computer teachers and school district technology specialists. Other enablers such as funding for technology tools, support by the *Infusing Technology Institute's* mentor and presenters, and administrative endorsement were noted by participants.

Teacher Support. During the focus groups, over half of the interviewed participants discussed how helpful other teachers were in troubleshooting technology issues and integrating the technology in their classrooms. In one focus group, the participants identified a teacher who supported several teachers in their efforts to use technology:

Participant 1: I go to Tracy. She teaches next door.

Participant 2: Yeah, Tracy's a big help.

Participant 1: She's trying to be a TIS and she does a lot of in-services for our school. She teaches us how to use the Smart Board™, how to use Thinkfinity. She's done Examview responders. We've been trained on all of that...She's a wonderful resource.

Participant 1: Definitely, definitely, Tracy.

Participant 3: We [another teacher sitting next to her] work across the hall. And, I'm on the phone "How you do this? How you do this? How you do this [sic]?" You know.

Interviewer: Did you work together before this program?

Participant 3: Yeah. But now, I mean, because you know she installs things, tests on [sic], you know, we've used responders, and if I'm on there and I have a problem I call her. "This is what happened," but if it's something that I'm trying to learn and she's busy I always go to Tracy who's down the hall.

Interviewer: Another teacher?

Participant 3: Oh Yeah. And then we have a really good technology guy. You know, he's the tech. ed. teacher. Yeah, teachers at our school help each other with everything…

A computer teacher was also identified as a support to using technology with students. An elementary group of participants discussed how helpful it was for them to have a computer teacher available full-time to work with the teachers and the students using technology:

Participant 1: Well, we have a computer teacher that we pay for, our county doesn't pay for, but our school pays for; she is very helpful.

Participant 2: [Agrees] There you go, Missy [name of computer teacher].

Interviewer: Does she come into your classroom?

Participant 1: No, we have a computer lab, and we go to the computer lab three days a week.

Interviewer: Does she work with you, or does she work with the kids all by herself?

Participant 1: No, no, we're there.

Participant 2: No, we have to work with her.

Interviewer: Does she do [teach] the lessons?

Participant 1: She does some, she does the techSteps™.

Participant 2: A lot of times she would. She does the techSteps™ because I'm not real [sic] familiar with the techSteps™, and I missed the training on it, so she does it.

Participant 1: But we work with her on the techSteps™ like she'll say, "Now this is our techStep™ project."

Participant 2: "Where do you want to go with this?"

Participant 1: "How do you want to incorporate this into your curriculum?"

Technology Access. Several of the participants talked about how their access to technology made it possible for them to integrate it into their curriculum. One middle school teacher described how technology was typically available for her to use with her students:

Participant 1: We're pretty well equipped at our school. We have Whiteboards. Well, not everyone, Jenna's is in the home ec. room right now. We have Elmos® for every team, and data projectors. Two Flipcams just showed up in my mailbox the other day. I don't know where they came from. I have no idea where they came from.

Participant 2: Better not to ask.

Participant 1: I know. I said "Does anyone know where these came from?" And they said "No" and I said "Thank you."

Interviewer: Have you used the Flipcams in your classroom?

Participant 1: We haven't used them yet. We haven't done anything with them yet. They've [students] seen them; they know we have them. They know it's coming. And actually, I told them that their homework this weekend was to go home and think about if they were going to produce a video to go with their script [PSA script], what would it be? And then they'll get together Monday and they'll talk because they are actually going to do that.

Another group of elementary teachers discussed the abundance of technology at their school, and their motivation to learn due to the encouragement of their administration to use technology:

Participant 1: I think I've let my kids use it more [since the *Infusing Technology Institute*], so than just me using it for presentations. My kids are using the video cameras and microphones; stuff like that that they haven't gotten to use before [prior to the *Institute*]. I've gotten an Elmo®. I've got some responders; I'm using those now. And some of the websites like Portaportal I'm using.

Participant 2: …At our school, we had a lot of technology before this class started. And our principal is very pushy. She is very driven. We are pushed hard to learn it [technology].

Participant 1: We had Elmos® in the classroom, Smart Boards™ before [prior to the *Institute*]. Martha had a flip camera.

Mentor Support. Several of the participants described the supportive relationship with their *Infusing Technology Institute* mentor and presenters, while some indicated they were more comfortable asking other teachers for technology support. The *Infusing Technology* mentor's job was to visit the schools once a month and provide feedback and support via email and the *Infusing Technology* wiki. For example, an elementary teacher described how helpful it was to have the support of her mentor as well as one of the *Institute's* presenters:

Participant: She's [her mentor] helpful. She came in and showed me the other evening. I stayed after school, and she showed me the Mimio®; and put it up there [on the board]. And if it had been a different week, I would have probably used it every day and really gotten into it. It's just that I was buried last week.

Interviewer: Is that something that you see yourself using?

Participant: Oh yes, Oh yes, yes. When you haven't had a Smart Board™ and everybody else has [other teachers] yeah, I'll figure it out. If I can ever get that splitter cord thing [sic] I'll be, I'll be tickled. She's [looking at an *Institute* presenter] was a really big help too because we're in Destination. She's been really helpful. She'll answer every kind of question you have. She does. She really does.

Interviewer: And you have access to her [*Institute* presenter] how?

Participant: Well, I don't unless you're a Title 1…You can call her and ask her something though.

Interviewer: She's [*Institute* presenter] the TIS for your county right? Is she aTIS for your county?

Participant: Just for the Title 1 schools…If you're not Title 1 you don't get all that money. And you don't get all those services.

As helpful as the mentors were for one middle school teacher, other teachers at her school were more accessible for technology support rather than contacting the mentor:

Participant: …It's just that I've never asked a question [to the mentor] and I've never emailed anybody and needed help and didn't get a response, or didn't get the help I needed. You know what I'm saying. But I think where we [other teachers at her school] are so close [sic]. A lot of schools aren't like ours. Where we're so close knit, we don't have to go to that source. Does that make sense? But when I do email Grace [mentor] or use the outside mentors [presenters] it's helpful.

Ancillary Findings.

Participants of the *Infusing Technology Institute* reported additional demographic data on the *LoTi Digital-Age Survey* that was used to prepare descriptive statistics and determine any changes from pre to post in how often students used digital tools and resources, how often students used computers in their classrooms, and how often teachers used digital tools and resources.

Descriptive Statistics. The following demographics were reported in the *LoTi Digital-Age Survey* and described and presented in previous tables of this chapter:

- years of teaching experience (see Table 10)
- age (see Table 10)
- level of education (see Table 10)
- greatest obstacle to technology integration (see Table 20)

Additional demographics reported in the survey are described and presented in the following tables:

- number of computers in classroom (see Table 24)
- how often students use computers (see Table 26)

- individual who provides technology inspiration and/or direction (see Table 23)
- teacher use of digital tools and resources (see Table 27)
- student use of digital tools and resources (see Table 25)

Participants selected from the following number of classroom computers to establish how accessible computers were in their classrooms: (a) none, (b) one to two, (c) three to five, or (d) more than five. The majority of participants identified having three to five classroom computers on both pre (*f*=22, P=51.2) and post (*f*=16, P=47.1), as shown in Table 24.

Table 24. Pre and Post Number of Classroom Computers

	Pre		Post	
Number of Classroom Computers	*f*	P	*f*	P
	n=43		n=34	
None	1	2.3	1	2.9
One to two	12	27.9	10	29.4
Three to five	22	51.2	16	47.1
More than five	8	18.6	7	20.6

Prior to participating in the *Infusing Technology Institute* the greatest number of teachers indicated that their students were using digital tools and resources *at least once a week* (*f*=19, P=45.2), as shown in Table 25. On post surveys, the greatest number of teachers reported that students' use of digital tools and resources had increased to *once a day* (*f*=16, P=45.7). Further analysis reveals minimum scores on pre surveys reported students *never* using digital tools and resources (*f*=1, P=2.4) and on post surveys minimum scores reported *once a day* (*f*=14, P=40).

Table 25. Pre and Post Student Use of Digital Tools and Resources

Student Use of Digital Tools and Resources	Pre		Post	
	f	P	*F*	P
	n=42		n=35	
Never	1	2.4		
At least once a month	4	9.5		
At least once a week	19	45.2	14	40.0
At least once a day	12	28.6	16	45.7
Multiple times each day	6	14.3	5	14.3

Several teachers indicated that their students were using computers, as shown in Table 26, prior to participating in the *Infusing Technology Institute*. Comparing pre and post survey results, there were decreases in the amount of students who were using computers *a few times a year* (from *f*=1,P=2.3 to *f*=0, P=0) and *a few times a month* (from *f*=11, P=26.2 to *f*=2, P=5.7), and increases in students using computers *a few times a week* (from *f*=17, P=40.5 to *f*=19, P=54.3) and *daily* (from *f*=13, P=31 to *f*=14, P=40).

Table 26. Pre and Post Student Computer Usage

Student Computer Usage	Pre		Post	
	f	P	*f*	P
	n=42		n=35	
A few times a year	1	2.3		
A few times a month	11	26.2	2	5.7
A few times a week	17	40.5	19	54.3
Daily	13	31.0	14	40.0

Teachers indicated a change in how often they used digital tools and resources prior to participating in the *Infusing Technology* Institute. A comparison of pre and post results shows that there were decreases in the number of teachers who were using digital tools and resources *never* (*f*=1, P=2.3 to *f=0, P=0*), *at least once a month* (*f*= 4, P=9.3to *f=0*, P=0), *at least once a week* (from *f*=10,P=23.3 to *f*=4, P=11.4) and *at least once a day* (from *f*=15, P=34.9 to *f*=10, P=28.6), and increases in teachers using digital tools *multiple times each day* (from *f*=13, P=30.2 to *f*=21, P=60), as shown in Table 27.

Table 27. Pre and Post Teacher Use of Digital Tools and Resources

Teacher Digital Tools and Resources	Pre *f*	Pre P	Post *f*	Post P
	n=43		n=35	
Never				
At least once a month				
At least once a week	1	2.3		
At least once a day	4	9.3		
Multiple times each day	10	23.3	4	11.4
	15	34.9	10	28.6
	13	30.2	21	60.0

Two-related Samples Wilcoxon Matched-pairs Signed-rank Test. The two-related samples Wilcoxon matched pairs signed-rank test was used to determine if there was a statistically significant difference between pre and post responses to how often students used digital tools and resources, how often students used computers in their classrooms, and how often teachers used digital tools and resources. Significant differences were identified in two of the three areas: how often students used computers in their classrooms and how often teachers used digital tools and resources.

Participants identified a significant increase in how often students used computers in their classrooms. Table 28 shows the frequency of negative (4), positive (12), and tied (18) ranks indicating that the majority of teachers stayed the same (18) in how often students used computers in the classroom.

Table 28. Wilcoxon Signed-Ranks Test Statistic: Pre/Post Student Computer Use

Ranks	*f*	Mean Rank	Sum of Ranks
Negative Ranks	4[a]	8.50	34.00
Positive Ranks	12[b]	8.50	102.00
Ties	18[c]		
Total	34		

a=PostStudentComputerUse<PreStudentComputerUse, b=PostStudentComputerUse>PreStudentComputerUse, c=PostStudentComputerUse=PreStudentComputerUse

The difference in pre to post student computer use was statistically significant (z-2.000, p=.046), as shown in Table 29.

Table 29. Test Statistic[b]: Pre/Post Student Computer Use

Statistic	Pre LoTi- Post LoTi
Z	-2.000[a]
Asymp Sig. (2 Tailed)	.046*

a. Based on negative ranks, b. Wilcoxon signed-ranks test, *p<.05

There was also a significant increase in how often teachers used digital tools and resources from pre to post based on the *LoTi Digital-Age Survey*. Table 30 shows the frequency of negative (3), positive (18), and tied (14) ranks indicating the majority (18) identified an increase in how often teachers used digital tools and resources.

Table 30. Wilcoxon Signed-Ranks Test Statistic: Pre/Post Teacher Use of Digital Tools and Resources

Ranks	*f*	Mean Rank	Sum of Ranks
Negative Ranks	3[a]	9.67	29.00
Positive Ranks	18[b]	11.22	202.00
Ties	14[c]		
Total	35		

a=PostTeacherDigitalTools<PreTeacherDigitalTools, b=PostTeacherDigitalTools>PreTeacherDigitalTools, c=PostTeacherDigitalTools=PreTeacherDigitalTools

The difference in pre to post teacher use of digital tool and resources was statistically significant (z= -3.088, p=.002), as shown in Table 31.

Table 31. Test Statistic[b]: Pre/Post Teacher Use of Digital Tools and Resources

Statistic	Pre LoTi- Post LoTi
Z	-3.088[a]
Asymp Sig. (2 Tailed)	.002*

a. Based on negative ranks, b. Wilcoxon signed-ranks test, $^{*}p<.05$

CHAPTER FIVE: SUMMARY AND DISCUSSION

The purpose of this study was to identify whether a quality professional development course, *Infusing Technology*, influenced teachers' integration of technology, their use of digital tools and resources, and instructional practices. Focus groups were conducted to identify constraints and enablers experienced by participants and the influences *Infusing Technology* had on the participants' teaching. The following research questions were used to explore the influence of the *Infusing Technology Institute*:

1. How did the *Infusing Technology Institute* affect the teachers' level of technology innovation?
2. How did the *Infusing Technology Institute* affect the teachers' level of personal computer use?
3. How did the *Infusing Technology Institute* affect the teachers' level of current instructional practices?
4. What did the teachers perceive as constraints to implementing the technology as learned from the *Infusing Technology Institute*?
5. What did the teachers perceive as enablers to implementing the technology as learned from the *Infusing Technology Institute*?

Population

The participants in this study were 21 elementary and 22 middle school teachers in West Virginia whose schools were chosen to participate in the *Infusing Technology Institute* based on their submitted applications. Applicants were chosen based on the school's expressed need and desire to learn more about how to integrate technology into the curriculum (L. Sparks, personal communication, July 22, 2009). There were 43 participants who completed the LoTi Digital-Age pre survey and 35 completed the post. Focus group interviews had 23 contributing participants.

Methods

This study used mixed-methods to determine the influence of the *Infusing Technology* professional development course on participants. A Quasi-Experimental pre and post evaluation design, used the *LoTi Digital-Age Survey*, to determine the influences the *Infusing Technology Institute* had with regard to levels of technology innovation (LoTi), personal computer use (PCU), and current instructional practices (CIP). The *LoTi Digital-Age Survey* was administered to participants as a pre-assessment prior to receiving training and as a post-assessment seven months after participants had time to implement the content learned from the *Infusing Technology* training. Focus groups were also conducted by the researcher during a follow-up training to explore the participants' perceived constraints and enablers to integrating technology in their classrooms and triangulate the data obtained from the *LoTi Digital-Age Survey*.

Findings

Technology Integration

Twenty-first century skills, such as using digital tools and resources to promote higher order thinking, engage student learning, and authentic assessment practices, were measured using the *LoTi Digital-Age Survey* (LoTi Connection, 2009). The survey results identified no significant differences in the participants' pre to post LoTi scores, but descriptive statistics revealed positive movement from the lower LoTi Intensity Levels to more advanced LoTi Intensity Levels. The focus group interviews identified participants' misconceptions and a lack of confidence regarding the *transforming uses* level of Grappling's Technology and Learning Spectrum, and understanding of its importance, while others were successful in reaching this level of integration. Concern about the developmental readiness of students to participate in a *transforming uses* project and a need for more implementation time was also noted.

Digital Tools and Resources

The *LoTi Digital-Age Survey* results identified a significant positive difference in participant' personal computer use (PCU) pre to post scores. The higher the PCU Intensity Level, the more depth and breadth of current and emerging digital tools used (LoTi Connection, 2009). Focus group interviews revealed an increase in the participants' comfort level in using digital tools and resources, as well as an increase in the use of technology with their students.

Instructional Strategies

LoTi Digital-Age Survey results identified a significant positive difference in the participants' current instructional practices (CIP). Teachers with a higher CIP Intensity Level have more of a learner-based instructional approach versus a subject-matter approach. Feedback from focus groups provided further evidence that teachers had altered their instructional approaches based on constructivist principles to provide more student directed, authentic problem-solving opportunities, and methods of differentiating instruction.

Constraints

Focus group interviews with 23 of the participants revealed several common constraints, such as a lack of time to learn and use technology with students, lack of assistance with technology software and hardware, equipment failure, and access to technology, computer labs, or Internet sites. Substitute teachers' lack of technology knowledge and expertise was also noted. These constraints may have influenced the participants' ability to effectively integrate technology during the course of the study and caused frustration. Responses to the *LoTi Digital-Age Survey* identified time to learn, practice, and plan was perceived by participants as the greatest obstacle to integrating technology.

Enablers

Focus group interviews also revealed enablers to integrating technology, such as support from other teachers, computer teachers, and school district technology specialists at the participants' schools, having the necessary funding for technology tools, and the assistance from the *Infusing Technology Institute* mentors and presenters. The motivation by school administration to use technology with students was noted. These support systems were crucial in providing participants with the necessary assistance in using digital tools and resources. Responses to the *LoTi Digital-Age Survey* identified other teachers as participants' main source of technology support and guidance.

Technology Integration Conclusions and Related Research

A 21st century curriculum is one where students and teachers use digital tools and resources to communicate, access, manage, integrate, and create information (Partnership for 21st Century Skills, 2004). Solely, providing teachers with technology tools and resources has not significantly influenced student learning (Caverly, Peterson, & Mandeville, 1997; Oppenheimer, 1997, 2004; Trotter, 1998; Wetzel, 2001). Technology integration requires the knowledge of and proficiency in the technology integration roles created by the International Society for Technology in Education (ISTE), Partnership for

21st Century Skills (P21), and the State Educational Technology Directors Association (SETDA):

1. Use technology for developing 21st century skills
2. Support innovative teaching and learning using technology
3. Create strong education support systems that use technology (ISTE, P21, SETDA, 2007)

The ultimate goal of learning to use digital tools and resources is to be able to integrate technology using the proposed three technology integration roles. The highest level of technology integration, *transforming uses*, allows students to communicate, collaborate, and develop more complex higher-order thinking skills (Porter, 2002). Study results found that many participants struggled with creating and implementing *transforming uses* types of activities. This concept had not yet been mastered and may have caused the participants difficulty in implementing the three technology integration roles with their students. According to Hall and Hord's (1987) change model, the participants were in stage three, *personal*, with general confusion and lack of confidence in their ability to understand how to create and implement a *transforming uses* activity. This may have been the reason their LoTi scores did not increase significantly from pre to post.

Teachers must be comfortable using digital tools and resources for successful integration into their curriculum. In several studies, teachers reported that because they had not received quality technology professional development opportunities, they were not comfortable using technology effectively (National Center for Education Statistics, 2000; Rakes & Casey, 2002; Stolle, 2008). Quality professional development, according to Backus (2005), must offer:

1. Training based on the needs of the teachers
2. A collaborative design
3. A sustained ongoing process of improvement and feedback
4. Embedded within the daily work experience of participants
5. Reflection opportunities
6. Provisions to evaluate the impact of training

In this study, results found that teachers who received quality technology training in using digital tools and resources used them more fluently with their students and increased the intensity, extent, and dedication of their use of current and emerging technology in their classrooms.

Technology integration requires teachers to not only understand digital tools and resources, but to change instructional practices to meet the demands of 21st century learners. Teachers who want to successfully integrate technology should examine their instructional practices and look for opportunities where students can communicate, access, manage, integrate, and create information (Partnership for 21st Century Skills, 2004). This study found that teachers who had participated in a quality technology professional development also changed their instructional practices to include student-directed learning, varied assessment strategies, authentic problem-solving opportunities, differentiated instruction, and complex classroom routines (LoTi Connection, 2009).

One instructional strategy, problem-based learning (PBL), was a strategy taught during *Infusing Technology*, and participants had an opportunity to participate in a PBL activity. Once participants were trained in using PBL, they were required to create and implement a PBL project with their students. This instructional approach centers on authentic problems and using inquiry-based or discovery learning (NFIE, 1997). With the PBL model, students construct their own interpretation of issues within a constructivist learning environment. Teachers have more opportunities to transform teaching and learning through the use of technology using a team-based approach to support higher order thinking skills (Bloom, 1956) and interpersonal skills (Michaelsen, 2001). According to a Meta-synthesis study that examined studies comparing PBL to traditional teaching practices (Strobel & van Barnveld, 2009), students learning in a PBL environment were significantly more competent and skilled, had longer retention rates, and higher scores on standardized test questions that required more elaboration than a multiple-choice or true/false question. The changes in current instructional practices levels of the participants may have been influenced by their *Infusing Technology* training in using problem-based learning.

Constraints such as time, access to technology, and other priorities made it difficult for participants to integrate technology. This study identified time to learn, practice, and plan for the use of technology in their classrooms to be the chief constraint for participants. In several other studies, teachers reported that time to learn and practice technology was also the biggest barrier to implementing technology (Hew and Brush, 2007; Littrell, Zagumny & Zagumny, 2005; National Center for Education Statistics, 2000; Rakes & Casey, 2002). Providing teachers with enough time to learn and use digital tools and resources may increase their ability to create learning experiences using technology that promote higher order thinking, engagement of students, and more authentic assessment practices.

Teachers must have technology support to meet their immediate needs when trying to integrate technology into the curriculum. This study identified that collaborating with teachers in the same school was the most commonly used form of technology support, along with the importance of having the necessary digital tools and resources. Porter (2002) suggests that each of the following four areas must be addressed for teaching and learning to be influenced by using technology:

1. Readiness for change
2. Teaching and learning
3. Technology Deployment
4. System Capacity

The third area, Technology Deployment, describes the need for the distribution of resources. This coincides with this study's results that resources, such as knowledgeable teachers and technology tools, were crucial for teachers to integrate technology effectively.

Implications

Education in the 21st Century requires teachers to understand how to effectively integrate technology into the curriculum, so they can prepare students for a digital workforce. Federal and state education policymakers should consider the following implications when reviewing and evaluating policies and curriculum standards geared towards teaching 21st century skills and prioritizing funding for technology tools and professional development. The results of this study imply that:

1. More quality technology professional development is needed that aligns with Backus' (2005) model of quality professional development.
2. Teachers need more training on developing and implementing *transforming uses* activities.
3. A quality technology professional development course can significantly influence how often teachers use digital tools and resources with their students.
4. A quality technology professional development course can significantly influence how often students use computers in the classroom.
5. A quality technology professional development course can significantly influence teachers' instructional strategies.
6. Teachers need time to learn, practice, and plan for the use of technology with students.
7. Substitute teachers need more opportunities to learn, practice, and plan for the use of technology with students.
8. Teachers who have direct access to technology experts, such as a full-time technology integration specialist, in their school benefit from this support.
9. Teachers need to be flexible and have alternative lessons available to eliminate time wasted solving constraints, such as equipment failure, when using technology.

Recommendations for Further Study

This study provided insight into the influence of a quality technology professional development course on West Virginia teachers' integration of technology, personal computer use, and current instructional practices. Recommendations for further research include:

1. Participants had difficulty understanding how to create and implement more *transforming uses* types of activities. Therefore, more professional development trainings on the development and implementation of *transforming uses* activities could be beneficial, and a study on the long-term influences is recommended.
2. Participants who used their students and other staff such as building administrators, college professors and vendors scored at higher intensity levels on current instructional practices. Therefore, future studies on technology support systems and their influence on teachers' use of technology are recommended.
3. A major constraint identified by participants was time to learn, practice, and plan using technology. Therefore, future studies on time management techniques and the influence on technology integration are recommended.
4. A major enabler to integrating technology identified by participants was the support of other teachers at their schools. Therefore, future studies on the influence of collaboration and communication with other teachers and their ability to effectively integrate technology are recommended.
5. Repeating this study after the participants have been involved in this professional development institute for another year would be beneficial to see the long-term influences on technology integration, personal computer use, and current instructional practices.
6. A more focused qualitative study on the specific digital tools and resources the participants learned and used in their classrooms would provide technology

professional development coordinators with specific data to develop new programs of study.

7. A study using a larger population of teachers or one that does not use self-reporting methods may yield unique results.

REFERENCES

Adams, S. (2005). A strategy for technology training as part of a master's program conducted at a school site. *Journal of Technology and Teacher Education, 13*(3), 493-514.

Apple Classrooms of Tomorrow-Today. (2008). *Learning in the 21st century*. Retrieved April 15, 2009, from http://images.apple.com/education/docs/leaders/Apple-ACOT2Whitepaper.pdf

Backus, M. (2005). A descriptive analysis of the quality of staff development experiences as perceived by West Virginia teachers. Ed.D. dissertation, Marshall University, United States -- West Virginia. Retrieved November 18, 2009, from Dissertations & Theses, Marshall University. (UMI No. 3213972)

Bauer, J., & Kenton, J. (2005). Toward technology integration in the schools: Why it isn't happening. *Journal of Technology and Teacher Education, 13*(4), 519-546.

Becker, H. J. (1994). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. *Journal of Research on Computing in Education, 26*(3), 291-322.

Birman, B., Desimone, L., Porter, A. C., & Garet, M. (2000, May). Designing professional development that works. *Educational Leadership, 57*(8), 28-33.

Bloom, B. S. (1956). *Taxonomy of Educational Objectives, the classification of educational goals – Handbook I: Cognitive Domain.* New York: McKay.

Bogdan, R. C., & Biklen, S. K. (2003). *Qualitative research for education: An introduction to theories and methods.* Boston, MA: Pearson Education Group, Inc.

Bork, A. (1980). Interactive learning. In R. Taylor (Ed.), *The computer in school: Tutor, tool, tutee* (pp. 53-66). New York: Teachers College Press.

Brodigan, D. L. (1992, Winter). Focus group interviews: Applications for institutional research. *The Association for Institutional Research, 43,* 1-6.

Bruner, J. (1973). *Going Beyond the Information Given*. New York: Norton.

Buck Institute of Education. (2007). *Handbook: Introduction to Project Based Learning.* Retrieved August 30, 2009, from http://www.bie.org/index.php/site/PBL/pbl_handbook_introduction/#standards

Burns, M. (2002). From black and white to color: Technology, professional development, and changing practice. *T.H.E. Journal, 29*(11), 36–42.

Carvin, A. (2004). *EdWeb Constructivism*. Retrieved April 18, 2009, from http://www.edwebproject.org/constructivism.basics.html

Caverly, D. C., Peterson, C. L., & Mandeville, T. F. (1997, November). A generational model for professional development. *Educational Leadership, 55*(3), 56-59.

Chappell, A. (2006). Using the 'grieving' process and learning journals to evaluate students' responses to problem-based learning in an undergraduate geography curriculum. *Journal of Geography in Higher Education*, *30*(1), 15-31.

Cole, K., Simkins, M., & Penuel, W. R. (2002). Learning to teach with technology: Strategies for inservice professional development. *Journal of Technology and Teacher Education, 10*(3), 431–455.

Constraints. (n.d.). *The American Heritage® Dictionary of the English Language, Fourth Edition*. Retrieved October 05, 2009, from http://dictionary.reference.com/browse/constraints

Crockett, M. D. (2002). Inquiry as professional development: Creating dilemmas through teachers' work. *Teaching and Teacher Education, 18*, 609-624.

Cuban, L., Kirkpartick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal, 38*(4), 813-834.

Daggett, W. R. (2008). *Rigor/Relevance Framework.* International Center for Leadership in Education. Retrieved November 16, 2009, from http://www.leadered.com/pdf/R&Rframework.pdf

Davis, F. (1980). A technology acceptance model for empirically testing new end-user information systems: Theory and results. Unpublished master’s thesis. Massachusetts Institute of Technology.

Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking to the educative process*. Boston: D.C. Heath.

Dockstader, J. (1999). Teachers of the 21st century know the what, why, and how of technology integration. *Technology Horizon in Education Journal, 26*(6), 73–74.

Dwyer, D. C., Ringstaff, C., & Sandholtz, J. H. (1990). *Teacher beliefs and practices part I: Patterns for change apple classrooms of tomorrow research report 8*. Retrieved September 30, 2009, from http://www.apple.com/euro/pdfs/acotlibrary/rpt8.pdf#search='The%20Evolution%20of%20Teachers%E2%80%99%20Instructional%20Beliefs%20and%20Practices%20in%20HighAccesstoTechnology%20Classrooms’

Enabler. (n.d.). *The American Heritage® Dictionary of the English Language, Fourth Edition*. Retrieved October 05, 2009, from http://dictionary.reference.com/browse/enabler

Forum on Education Statistics. (2002). *Technology in schools: Suggestions, tools and guidelines for assessing technology in elementary and secondary education*. Retrieved April 15, 2009, from http://nces.ed.gov/pubs2003/tech_schools/index.asp

Francis-Pelton, L., Farragher, P., & Riecken, T. (2000). Content based technology: Learning by modeling. *Journal of Technology and Teacher Education, 8*(3), 177-186.

Franklin, T., Duran, M., & Kariuki, M. (2001). Mentoring overcomes barriers to technology integration. In J. Price et al. (Eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference 2001*, Chesapeake, VA: AACE, 848-849.

Fullan, M. (1999). *Technology and the Problem of Change*. Retrieved October 18, 2009, from http://www.michaelfullan.ca/Articles_98-99/12_99.pdf

Gorder, L. (2009). Is technology integration finding its way into the classroom? *Journal for Computing Teachers.* Retrieved October 12, 2009, from http://www.iste.org/Content/NavigationMenu/Membership/SIGs/SIGCS_Computer_Science_/JCTJournalforComputingTeachers/PastIssues/2009/Spring/gorder_technology.pdf

Gningue, S. (2003). The effectiveness of long term vs. short term training in selected computing technologies on middle and high school mathematic teachers' attitudes and beliefs. *Journal of Computers in Mathematics and Science Teaching, 22*(3), 207–224.

Guerrero, S., Walker, N., & Dugdale, S. (2004). Technology in support of middle grade mathematics: What have we learned? *Journal of Computers in Mathematics and Science Teaching, 23*(1), 5–20.

Gusky, T. (2002, March). Does it make a difference? Evaluating professional development. *Educational Leadership, 59*(6), 45-51.

Hall, G. E., & Hord, S. M. (1987). *Change in schools: Facilitating the process*. New York: State University of New York Press.

Hall, G. E., & Hord, S. M. (2001). *Implementing change: Patterns, principles and potholes*. Boston: Allyn and Bacon.

Healey, M., & Matthews, H. (1996). Learning in small groups in university geography courses: Designing a core module around group projects. *Journal of Geography in Higher Education*, *20*(2), 167.

Hew, K., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Education Tech Research Development*, *55*, 223-252.

Howland, J., & Wedman, J. (2004). A process model for faculty development: Individualizing technology training. *Journal of Technology and Teacher Education, 12*(2), 239-263.

International Society for Technology in Education. (2008). *The ISTE National Educational Technology Standards and Performance Indicators for Students and Teachers.* Retrieved April 18, 2009, from http://www.iste.org/

International Society for Technology in Education, Partnership for 21st Century Skills (P21), & the State Educational Technology Directors Association. (2007). *Maximizing the impact: The pivotal role of technology in a 21st century education system.* Retrieved April 16, 2009, from http://www.setda.org/c/document_library/get_file?folderId=191&name=P21Book_complete.pdf

Keeling, A. (2008). "We Are Scholars": Using Teamwork and Problem-Based Learning in a Canadian Regional Geography Course. *MountainRise, the International Journal of the Scholarship of Teaching and Learning*. Retrieved August 30, 2009, from http://www.wcu.edu/facctr/mountainrise/archive/vol4no3/html/UsingTeamworkandProblemBasedLearning.pdf

Keller, J., Bonk, C., & Hew, K. (2005). The TICKIT to teacher learning: Designing professional development according to situative principles. *Journal of Educational Computing Research*, *32*, 329-340.

Kotrlik, J., & Redmann, D. (2005, May). Extent of technology integration in instruction by adult basic education teachers. *Adult Education Quarterly, 55*(3), 200–219.

Kottkamp, R. (1990, Feb.). Means for facilitating reflection. *Education in Urban Society, 22*(2), 182-200.

Krueger, R. A., & Casey, M. A. (2000). *Focus groups: A practical guide for applied research.* Thousand Oaks, CA: Sage Publications.

Lawless, K., & Pellegrino, J. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research, 77*(4), 575-614.

Learning Theories Knowledgebase. (2009, August). *Problem-Based Learning (PBL) at Learning-Theories.com.* Retrieved August 29, 2009, from http://www.learning-theories.com/problem-based-learning-pbl.html

Littrell, A., Zagumny, M., & Zagumny L. (2005). Contextual and psychological predictors of instructional technology use in rural classrooms. *Educational Research Quarterly*, *29*(2), 37-47.

LoTi Connection. (2009). *LoTi: Heating up 21st century learning.* Retrieved October 5, 2009, from http://loticonnection.com/index.html

Marzano, R. J., Pickering D. J., & Pollock, J. E. (2001). *Classroom instruction that works: Research-based strategies for increasing student achievement.* Alexandria, VA: Association for Supervision and Curriculum Development.

Matzen, N., & Edmunds, J. (2007). Technology as a catalyst for change: The role of professional development. *Journal of Research on Technology in Education, 39*(4), 417-430.

McKenzie, J. (2003). Just in time technology. *From Now on-The Educational Technology Journal, 12*(5). Retrieved November 16, 2009, from http://fno.org/jan03/jitt.html

Michaelsen, L. K. (2001). *Getting started with team-based learning.* Retrieved November 16, 2009, from http://teambasedlearning.apsc.ubc.ca/d/GettingStartedwithTBL.pdf

Ministry of Education Standards Department. (2002). *Working with colleagues: A guide for ICT mentors.* Retrieved October 23, 2009, from http://www.bced.gov.bc.ca/technology/documents/mentors.pdf

Moersch, C. (1995). Levels of technology implementation (LoTi): A framework for measuring classroom technology use. *Learning and Leading with Technology, 23*(3), 40–42.

Moersch, C. (2001, November). Next steps: Using LoTI as a research tool. *Learning and Leading with Technology*, *29*(3), 22–27.

Moersch, C. (2010, February). LoTi turns up the HEAT! *Learning and Leading with Technology, 37*(5), 20-23.

Moore, K. A. (2008, January). Quasi-experimental evaluations. *Child Trend, 4.* Retrieved November 18, 2009, from http://www.childtrends.org/Files//Child_Trends-2008_01_16_Evaluation6.pdf

Mouza, C. (2006). Linking professional development to teacher learning and practice: A multi-case study analysis of urban teachers. *Journal of Educational Computing Research*, *34*, 405-440.

Mouza, C. (2009). Does research based professional development make a difference? A longitudinal investigation of teacher learning in technology integration. *Teachers College Record, 111*(5), 1195-1241.

National Center for Education Statistics. (2000). *Teachers' tools for the 21st century: A report on teachers' use of technology.* Retrieved October 11, 2009, from http://nces.ed.gov/surveys/frss/publications/2000102/index.asp?sectionID=2

National Foundation for the Improvement of Education. (1997). *Foundations for the road ahead: Project-based learning and information technologies.* International Society for Technology in Education. Retrieved November 16, 2009, from http://www.iste.org/content/navigationmenu/research/reports/the_road_ahead_background_papers_1997_/project-based_learning.htm

Oppenheimer, T. (1997, July). The computer delusion. *Atlantic Monthly*, *280*(1), 45-62.

Oppenheimer, T. (2004, February). The Internet school scam. *Nation*, *278*(6), 19-21.

Parsad, B., Lewis, L., & Farris, E. (2001). *Teacher preparation and professional development: 2000.* National Center for Education Statistics Report No. NCES 2001-088), Washington, DC: National Center for Education Statistics. Retrieved October 14, 2009, from http://nces.ed.gov/pubs2001/2001088.pdf

Partnership for 21st Century Skills. (2004). *Framework for 21st century learning.* Retrieved April 16, 2009, from http://www.21stcenturyskills.org/index.php?option=com_content&task=view&id=254&Itemid=120

Penuel, W., Boscardin, C., Masyn, K., & Crawford, V. (2007). Teaching with student response systems in elementary and secondary education settings: A survey study. *Educational Technology Research and Development*, *55*, 315-346.

Pierson, M. (2001). Technology integration as a function of pedagogical *expertise. Journal of Research on Computing in Education*, *33*(4), 413-430.

Porter, B. (2002). *Grappling with accountability 2002: MAPPing tools for organizing and assessing technology for student results.* Bernajean Porter, 2nd edition.

Porterfield, S. M. (2006). A case study of changed educational practices in response to the No Child Left Behind Act of 2001. D.Ed. dissertation, Indiana University of Pennsylvania, United States -- Pennsylvania. Retrieved November 18, 2009, from *Dissertations & Theses: Full Text.* (UMI No. 3206653)

Project Tomorrow. (2009). Speak *Up: March 24, 2009.* Retrieved October 11, 2009, from http://www.tomorrow.org/docs/SU08_selected%20national_findings_complete.pdf

Rakes, G., & Casey, H. (2002). An analysis of teacher concerns toward instructional technology. *International Journal of Educational Technology, 3*(1). Retrieved October 11, 2009, from http://www.ed.uiuc.edu/ijet/v3n1/rakes/index.html

Rodgers, C. (2002). Defining reflection: Another look at John Dewey and reflective thinking. *Teachers College, 104*(4), 842-867.

Rogers, E. M. (1962). *Diffusion of Innovations.* New York, NY: Macmillion Publishing Co.

Russell, A. L. (1995). Stages learning in new technology: Naïve adult email users. *Computers in Education, 25*(4), 173-175.

Sandholtz, J. (2001). Learning to teach with technology: A comparison of teacher development programs. *Journal of Technology and Teacher Education, 9*(3), 349-374.

Savery, J. (2006). Overview of problem-based learning: Definitions and distinctions. *The Interdisciplinary Journal of Problem-based Learning, 1*(1). Retrieved August 30, 2009, from *http://www.ijpbl.org/*

Schon, D. A. (1987). Educating the reflective practitioner: Toward a new design for teaching and learning in the professions. San Francisco: Jossey-Bass.

Serotkin, P. (2006). Understanding the paradigm shift: A descriptive case study of the impact of changes in information literacy instruction methods. Dissertation, Indiana University of Pennsylvania. (UMI No. 3237067)

Silverstein, G., Frechtling, J., & Miyoaka, A. (2000, Month). *Evaluation of the use of technology in Illinois public schools: Final report (prepared for Research Divisions, Illinois State Board of Education)*. Rockville, MD: Westat.

SRI International. (2002, May). *The integrated studies of educational technology: Professional development and teachers' use of technology.* Retrieved November 16, 2009, from http://policyweb.sri.com/cep/publications/SRI_Professional_Development_Report_2002.pdf

Stites, R. (1998). *Evaluation of project based learning: What does research say about outcomes from project-based learning?* San Mateo County Office of Education. Retrieved November 16, 2009, from http://www.coe.tamu.edu/~rcapraro/PBL/Evaluation%20of%20Project%20Based%20Learning.pdf

Stolle, E. (2008). Teachers, literacy, & technology: Tensions, complexities, conceptualizations, & practice. Reading Conference Yearbook. National Reading Conference. Milwaukee, WI.

Stoltzfus, J., (2006). Determining educational technology and instructional learning skill sets (DETAILS): A new approach to the LoTi framework for the 21st century. Retrieved June 12, 2009, from http://loticonnection.com/validandreliable.html

Strobel, J., & van Barneveld, A. (2009). When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms. *The Interdisciplinary Journal of Problem-based Learning, 3*(1), 44-58.

Toledo, C. (2005). A five-stage model of computer technology integration into teacher education curriculum. *Contemporary Issues in Technology and Teacher Education, 5*(2), 177-191.

Trotter, A. (1998, March 18). Educational-technology boosters feeling stung by media backlash. *Education Week, 17*(27), 14.

United States Department of Education. (2000a). *E-Learning: Putting a world class education at the fingertips of all children.* Retrieved September 26, 2009, from http://www.ed.gov/about/offices/list/os/technology/reports/e-learning.pdf

United States Department of Education. (2000b). *Teachers' tools for the 21st century: A report on teachers' use of technology*. Retrieved October 11, 2009, from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2000102

United States Department of Education. (2001). *Elementary & secondary education: Part D-Enhancing education through technology, section 2402.* Retrieved September 23, 2009, from http://www.ed.gov/policy/elsec/leg/esea02/pg34.html

United States Department of Education. (2004a). *National education technology plan.* Retrieved November 5, 2009, from http://www.ed.gov/about/offices/list/os/technology/plan/2004/site/edlite-actionsteps.html

United States Department of Education. (2004b). *Visions 2020: Student views on transforming education and training through advanced technologies.* Retrieved November 5, 2009, from http://www.ed.gov/about/offices/list/os/technology/plan/2004/site/documents/visions_20202.pdf

United States Department of Education. (2009). *Guidance on enhancing education through technology (Ed Tech) program funds made available under the American Recovery and Reinvestment Act of 2009.* Retrieved September 26, 2009, from http://www.ed.gov/programs/edtech/legislation.html

Vannatta, R. A., & Beyerbach, B. (2000). Facilitating a constructivist vision of technology integration among education faculty and preservice teachers. *Journal of Research on Computing in Education, 33*(2), 132-148.

Warschauer, M., & Grimes, D. (2005). *First year evaluation report Fullerton School District Laptop Program.* Retrieved November 16, 2009, from http://ftp.ics.uci.edu/pub/grimesd/Laptop-Year1-Eval.pdf

Webb, N. L. (2006*). Web Alignment Tool.* Wisconsin Center of Educational Research. University of Wisconsin-Madison.

Wedman, J., Laffey, J., Andrews, R., Musser, D., Diggs, L., & Diel, L. (1998). Building technology infrastructure and enterprises in a college of education: Increasing performance capacity. *Educational Technology, 5*(38), 12-19.

Wei, R. C., Darling-Hammond, L., Andree, A., Richardson, N., Orphanos, S. (2009). *Professional learning in the learning profession: A status report on teacher development in the United States and abroad.* Dallas, TX: National Staff Development Council.

Wells, J. (2007). Key design factors in durable instructional technology professional development. *Journal of Technology and Teacher Education, 15*(1), 101-122.

Wenglinski, H. G. (1998). *Does it compute? The relationship between educational technology and student achievement in mathematics.* Princeton, NJ: Educational Testing Services, Policy Information Center.

Wetzel, D. R. (2001). A model for pedagogical and curricular transformation with technology. *Journal of Computing in Teacher Education, 18*(2), 43-49.

Wiggins, G., & McTighe, J. (2005). *Understanding by Design.* Alexandria, VA: Association for Supervision and Curriculum Development.

West Virginia Department of Education. (2009). *A chronicle of West Virginia's Global21 initiative (2004-2009).* Retrieved October 23, 2009, from http://wvde.state.wv.us/tt/2009/WV%20Global21%20Chronicle%202009.pdf

West Virginia Department of Education. (n.d.). *West Virginia Department of Education: Strategic Goals*. Retrieved October 6, 2009, from http://wvde.state.wv.us/

Zuniga, R. (2009). Teacher perspectives on the current state of computer technology integration into the public school classroom. Ed.D. dissertation, The University of Texas - Pan American, United States -- Texas. Retrieved November 18, 2009, from Dissertations & Theses: Full Text. (UMI No. 3367217)

APPENDICES

Appendix A: Permission to Use Backus Table

Amy Cottle

From: Backus, Melinda [backus5@marshall.edu]
Sent: Friday, October 09, 2009 6:54 PM
To: aecottle@gmail.com
Subject: Re: Dissertation

Absolutely. Good luck with the work. Let me know if I can help in any way. Dr. Heaton is great to work with! Mb

Sent by BlackBerry, available from NTELOS Wireless

From: Amy Cottle <aecottle@gmail.com>
Date: Fri, 9 Oct 2009 15:16:31 -0400
To: Backus, Melinda<backus5@marshall.edu>
Cc: Heaton, Lisa<heaton@marshall.edu>
Subject: Dissertation

Dr. Backus,

Dr. Heaton and I are working on my dissertation about the influence of a professional development course on its participants, and we would like to use the characteristics you determined in your dissertation to determine if the professional development we are studying is quality.

I am writing to request your permission to reproduce the figure you included in Appendix B: Common Characteristics of Quality Staff Development of your dissertation. This illustration would be helpful in framing/explaining the theoretical framework of my study.

Please let me know if you give permission for me to use this figure in my dissertation.

Thanks for considering this request.

Amy E. Cottle
Marshall University Graduate Student
304-415-3367

1

Appendix B: Levels of Teaching Innovation (LoTi) Digital-Age Framework

LoTi Digital-Age Framework

The Levels of Teaching Innovation (LoTi) Framework was first conceptualized by Dr. Chris Moersch in 1994 as a research tool to assess authentic classroom technology use. Several iterations later, the original LoTi Framework has transformed into a conceptual model to measure classroom teachers implementation of the tenets of digital-age literacy as manifested in the National Educational Technology Standards for Teachers (NETS-T). The LoTi Framework focuses on the delicate balance between instruction, assessment, and the effective use of digital tools and resources to promote higher order thinking, engaged student learning, and authentic assessment practices in the classroom--all vital characteristics of 21st Century teaching and learning.

- LoTi Level 0 - Non-use
  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).
- LoTi Level 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.
- LoTi Level 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) using the available digital assets.

  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.

- Level 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 using the available digital assets.

  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.
- Level 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.
- Level 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.

- Level 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) using the available digital assets.

  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.
- Level 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.

Appendix C: Personal Computer Use (PCU) Framework

Personal Computer Use (PCU) Framework

The Personal Computer Use (PCU) Framework measures classroom teachers' fluency level with using digital tools and resources for student learning. As one moves to a higher PCU Intensity Level, the depth and breadth of current and emerging digital tool use (e.g., multimedia, productivity, desktop publishing, web-based applications) in the classroom increases proportionally as does the teacher's advocacy and commitment level for their use. At the highest PCU Intensity Levels, teachers assume leadership roles that transcend the everyday use of digital tools and resources toward a level of advocacy for effective technology use in their classroom, school building, and the larger global community.

- Intensity Level 0 (Not True of Me Now)
  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.
- Intensity Level 1 (Not True of Me Now)
  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.
- Intensity Level 2 (Not True of Me Now)
  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.
- Intensity Level 3 (Somewhat True of Me Now)
  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.
- Intensity Level 4 (Somewhat True of Me Now)
  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.

- Intensity Level 5 (Somewhat True of Me Now)
  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.
- Intensity Level 6 (Very True of Me Now)
  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.
- Intensity Level 7 (Very True of Me Now)
  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.

Appendix D: Current Instructional Practices (CIP) Framework

Current Instructional Practices (CIP) Framework

The Current Instructional Practices (CIP) Framework measures classroom teachers' current instructional practices relating to a subject-matter versus a learner-based instructional approach in the classroom. As one moves to a higher CIP Intensity Level, less emphasis is placed on didactic instruction, sequential and uniform learning activities, and traditional forms of assessment. In its place, teachers begin to embrace instructional strategies aligned with student-directed learning, varied assessment strategies, authentic problem-solving opportunities, differentiated instruction, and complex classroom routines (e.g., students generating and testing hypotheses, implementing cooperative learning, students identifying similarities and differences).

- Intensity Level 0 (Not True of Me Now)
  A CIP Intensity Level 0 indicates that the participant is not involved in a formal classroom setting (e.g., pull-out program).
- Intensity Level 1 (Not True of Me Now)
  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.

  Student projects tend to be teacher-directed in terms of identifying project outcomes as well as requirements for project completion. No effort is made to differentiate instruction. The use of research-based best practices focuses on basic classroom routines (e.g., providing homework and practice, setting objectives and providing feedback, students summarizing and note taking, providing adequate wait time).
- Intensity Level 2 (Not True of Me Now)
  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.

  Student projects tend to be teacher-directed in terms of identifying project outcomes as well as requirements for project completion. No effort is made to differentiate instruction. The use of research-based best practices focuses on basic classroom routines (e.g., providing homework and practice, setting objectives and providing feedback, students summarizing and note taking, providing adequate wait time).

- Intensity Level 3 (Somewhat True of Me Now)
  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.

  Evaluation techniques continue to focus on traditional measures with the resulting data serving as the basis for curriculum decision-making. The use of research-based best practices expands beyond basic classroom routines (e.g., providing opportunities for non-linguistic representation, offering advanced organizers).
- Intensity Level 4 (Somewhat True of Me Now)
  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.

  Although traditional learning activities and evaluation techniques are used, students are also encouraged to contribute to the assessment process when appropriate to the content being addressed. The amount of differentiation is moderate based on the readiness level, interests, and learning styles of the students. The use of research-based best practices expands beyond basic classroom routines (e.g., providing opportunities for non-linguistic representation, offering advanced organizers).
- Intensity Level 5 (Somewhat True of Me Now)
  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.

  Although student-directed learning activities and evaluations are the norm, the use of teacher-directed activities (e.g., lectures, presentations, teacher-directed projects) may surface based on the nature of the content being addressed and at the desired level of student cognition. The amount of differentiation is substantial based on the readiness level, interests, and learning styles of the students. The use of research-based best practices delves deeper into complex classroom routines (e.g., students generating and testing hypotheses, implementing cooperative learning, students identifying similarities and differences).

- Intensity Level 6 (Very True of Me Now)
  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.

  Students, teacher/facilitators, and occasionally parents are all involved in devising appropriate assessment instruments (e.g., performance-based, journals, peer reviews, self-reflections) by which student performance will be assessed. The amount of differentiation is substantial based on the readiness level, interests, and learning styles of the students. The use of research-based best practices delves deeper into complex classroom routines (e.g., students generating and testing hypotheses, implementing cooperative learning, students identifying similarities and differences).
- Intensity Level 7 (Very True of Me Now)
  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.

  Students, teacher/facilitators, and occasionally parents are all involved in devising appropriate assessment instruments (e.g., performance-based, journals, peer reviews, self-reflections) by which student performance will be assessed. The amount of differentiation is seamless since students completely guide the pace and level of their learning. The use of research-based best practices delves deeper into complex classroom routines (e.g., students generating and testing hypotheses, implementing cooperative learning, students identifying similarities and differences).

Appendix E: IRB Approval of Study

MARSHALL UNIVERSITY®
www.marshall.edu

Office of Research Integrity
Institutional Review Board
401 11th St., Suite 1300
Huntington, WV 25701

FWA 00002704

IRB1 #00002205
IRB2 #00003206

July 16, 2009

Lisa Heaton, Ph.D.

RE: IRBNet ID# 126143-1
At: Marshall University Institutional Review Board #2 (Social/Behavioral)

Dear Dr. Heaton:

Protocol Title:	[126143-1] Professional Development Institute, Infusing Technology, and Its Influence on How Teachers Use Technology	
Expiration Date:	July 15, 2010	
Site Location:	MUGC	
Type of Change:	New Project	APPROVED
Review Type:	Exempt Review	

In accordance with 45CFR46.101(b)(1), the above study and informed consent were granted Exempted approval today by the Marshall University Institutional Review Board #2 (Social/Behavioral) Chair for the period of 12 months. The approval will expire July 15, 2010. A continuing review request for this study must be submitted no later than 30 days prior to the expiration date.

This study is for student Amy Cottle.

If you have any questions, please contact the Marshall University Institutional Review Board #2 (Social/ Behavioral) Coordinator Bruce Day, CIP at (304) 696-4303 or day50@marshall.edu]. Please include your study title and reference number in all correspondence with this office.

- 1 -

Appendix F: Grappling's Technology and Learning Spectrum with Permission

Grappling's Technology and Learning Spectrum

Technology Literacy Uses

Technology Focus - Learning/Acquiring/Practicing **Technology Skills NOT Curriculum** *
"Just-in-case" technology skills are acquired for possible future needs
- *Literacy classes*
- *Learning hardware and software*
- *Students projects are technology focused rather than expecting standards to intentionally drive the use of technology for learning*
- *Curriculum provides "topics" for technology uses*

Instructional Focus
Technology-centered pedagogy
- *Teacher talk is "technology talk" rather than "learning talk."*

Technology uses are organized for their own sake
- *Acquiring and assessing technical skills*
- *Offered as separate and/or optional experiences/programs*
- *Allowed when "real work" is completed or considered alternative/"reward" activities*
- *Research done to learn tools and processes*
- *Teachers view technology as something to learn or do*

* NOTS Content

Staff Development Focus
Designated "experts" tend to be self-initiating in learning on their own. Other interested staff mostly learn on their own time and own dime.

Adapting Uses

Technology Focus - Optional/Adaptive Learning Tasks-InformationConsumers *
Integrating is translated into "use it for something, anything…just use it"
- *Drill and practice with content software*
- *Instructional games*
- *Productivity tools used to adapt assignments/tasks given in the past without technology*
- *Curriculum provides "topics" for technology uses*

Instructional Focus
Teacher-centered, Direct Instruction pedagogy
- *Teacher talk is "same stories with new tools" – there is confusion that new tools make new instructional stories.*

Technology uses are adapted/provided but still optional for traditional curriculum goals.
- *Teacher and student roles remain the same*
- *Learning/assessment practices are unchanged*
- *Student experiences depend upon teacher directed assignments*
- *Research is "go look up" and "tell me back" (LOTS)*
- *Teachers view technology as interesting but optional and not necessary to achieve present curriculum goals*

* CLOSED or LOTS Questions

Staff Development Focus
Participation and support while encouraged is still optional as well as unfocused. Staff development funding is inadequate – less than 30% of total technology budget supports staff development.

Transforming Uses

Technology Focus - Essential -Information Producers *
Integrating is "just-in-time" technology skills as needed for learning tasks /projects
- *Complex learning and thinking tools*
- *Community learning tools*
- *Assessment tools*
- *Productivity tools used to construct meaning, and produce information useful and beneficial to others*

Instructional Focus
Student-centered, constructivist pedagogy
- *Teacher talk is "new stories with new tools."*

Technology uses enable new learning tasks not possible without technology
- *Student roles expand to include explorers, producers of knowledge, communicators and self-directed learners*
- *Teacher roles expand to include facilitators, designers, learners, and researchers*
- *Learning and assessment practices are changed*
- *Students initiate technology uses as they create their own learning experiences*
- *Research is sustained inquiry for original thinking and conclusions useful to others*
- *Teachers view technology as essential for development of higher-order thinking skills (HOTS)*

* OPEN or HOTS Questions

Staff Development Focus
Essential skills and practices are articulated, expected, supported and measured for *all* teachers. Adequate funding of at least 30% of technology budget is in place.

Amy Cottle

From: Bernajean Porter [Bernajean@DigiTales.us]
Sent: Thursday, September 24, 2009 10:03 AM
To: aecottle@gmail.com
Subject: Re: Grappling's Spectrum

I designed and have used this spectrum since 1997 -- it was first officially published in 1999 as a resource in my book Grappling with Accountability which was revised and updated in 2002 as a book and accompanying CD resource disk. The spectrum is at the heart of validated instructional assessment tools including the building walk-though observations - and is presently used by numerous districts as part of their instructional assessments. There have been no significant studies or research published since 2002 that would call for further modification of the tools at this time. I have conducted at least 2300 district impact studies using these tools.

You certainly have my permission to use this copyrighted tool in your dissertation . . . but I would like the courtesy of knowing your topic, degree program and present address. Any responses to how this tool was useful would be welcome as well . . . .

good speed to your diligent work
Bernajean

Here is the full book title:

Grappling with Accountability 2002: MAPPing Tools for Organizing and Assessing Technology for Student Results [UNABRIDGED] (Spiral-bound) AND CD

Amazon information source:
http://www.amazon.com/Grappling-Accountability-2002-Organizing-Technology/dp/0967075521/ref=sr_1_1?ie=UTF8&s=books&qid=1253800390&sr=1-1

Product Description
Annoucing Grappling with Accountability 2002, MAPPing Tools for Organizing and Assessing Technology for Student Results. (Book and Hybrid CD) This licensed resource is a comprehensive licensed toolkit of text and CD-ROM digital resources that guides planning groups with a step-by-step process to measure, analyze and plan (MAP) their nextsteps for increasing technology→ s impact on student results. Quantitative and qualitative assessment of twenty-four essential system indicators culminates in a MAPPing NextSteps for Instructional Technology report. Practical tools, templates, processes and strategies are culled from years of experience and aligned with national benchmarks and research. The data collection supports groups in organizing and assessing their technology resources in ways that focus on learning results rather than technical efforts. School districts will save thousands of dollars as well as considerable time by licensing the 85+ digitized and text toolkit of tools, templates and sample reports to construct their own data stories that target technology→ s impact on student results.

1

Appendix G: Permission to Use LoTi Survey in Study

LoTi Connection, Inc.
PO Box 130037 Carlsbad, CA 92013-0037
(V) 760-431-2232 (F) 760-946-7605
www.loticonnection.com

Letter of Permission to use LoTi:

July 10, 2009, 2009

To: Whom It May Concern:

Please accept this letter as notification that Dr. Christopher Moersch informed me that Amy Cottle will be using the LoTi Digital Age Survey to collect data for her doctoral dissertation study. Ms. Cottle has the permission of Dr. Moersch and LoTi Connection, Inc. to use the LoTi Digital Age Survey and the LoTi Framework for purposes of the study only. Ms. Cottle also has permission to review all available results on the individuals taking place in her study and reprint selected survey questions in the Appendix of the study.

For your reference, the LoTi Framework is posted at the LoTi Connection web site at:

http://www.loticonnection.com/lotilevels.html

Sincerely,

LeeChel Moersch

LeeChel Moersch
Director of Operations

Date 7/10/2009

Appendix H: Panel of Experts and Related Documents

Panel Members

John Huxley
Director of Regional Center for Distance Education and Professional Development
Marshall University, South Charleston, WV

Melanie White
Principal
Lighthouse Baptist Church, Hurricane, WV

Dr. Mindy Backus
Assistant Professor of Elementary/Secondary Education and Creator of Criteria for Quality Professional Development
Marshall University, South Charleston, WV

Dr. Ronald Childress
Professor of Elementary and Secondary Education
Marshall University, South Charleston, WV

Dr. Sue Hollandsworth
Assistant to the Dean and Certification Officer
Marshall University, South Charleston, WV

Yvonne Skoretz
Technology Mentor
West Virginia Center for Professional Development, Charleston, WV

Quality Professional Development Survey Cover Letter

Dear Education Professional,

You are invited to participate on a panel of experts to help determine whether or not a professional development course meets the criteria of a **quality** professional course. There are two additional documents provided. Please review *Technology Integration for Teachers Professional Development Course*, which describes the features of a professional development course. Then, read the statements on the *Quality Professional Development Checklist*, based on the list of criteria developed by Backus[1], and decide whether or not the description of the course fulfills the criteria.

Please accept my gratitude in advance for your cooperation and timely participation in this review of a professional development course.

Amy E. Cottle
Marshall University Graduate Student

[1] Backus, M. (2005). A descriptive analysis of the quality of staff development experiences as perceived by West Virginia Teachers. ProQuest Direct: UMI Number: 3213972.

Quality Professional Development Checklist

Determine whether or not the description of this staff development reflects each of the following statements by circling either YES or NO:

1. **Learning Needs**- The staff development plan addresses the needs of the teachers students by teaching content that is based on the NETS-T and NETS-S standards.

   YES NO

2. **Collaboration**-The staff development plan includes opportunities for teachers to collaborate with their peers and facilitators.

   YES NO

3. **Follow-up**- The staff development plan includes follow-up opportunities for teachers to apply knowledge, communicate, and reflect.

   YES NO

4. **Embedded**- The staff development plan includes learning opportunities for teachers during the regular work day.

   YES NO

5. **Reflection**- The staff development plan includes opportunities for teachers to reflect on their understandings and experiences related to the staff development content.

   YES NO

6. **Evaluated**- The staff development plan includes a plan to evaluate the perceptions of participants and success of the course.

   YES NO

Description of the Infusing Technology Course

Overview

This course was designed to meet the technology integration needs of West Virginia elementary and middle school teachers. It demonstrated best practice techniques for using technology in the classroom for elementary and middle school teachers, and taught the teachers ways to improve students' critical thinking, reasoning, and problem solving skills in a collaborative environment. In addition, participants had an expert mentor who continued to help them facilitate the technology in their classrooms after the initial training.

Mentor Responsibilities

- Attend mentor training
- Participate in professional development course and follow-up courses
- Work with school teams to develop infusing technology plan
- Ongoing support via email, wiki, WebEx
- Monthly onsite visits
- Provide progress reports to professional development planners

Timeline

Summer, 2009 Professional Development Agenda

Five days of professional development with $4,000 per school to purchase materials/supplies for classroom implementation.

Technology tools and instructional practices demonstrated and used in the course were based on the ISTE National Educational Technology Standards and Performance Indicators for Teachers (NETS-T) and for Students (NETS-S). In addition, The Partnership for 21st Century Skills' skill set was also used to identify necessary technology tools and instructional practices.

NETS-T Standards: (a) Facilitate and Inspire Student Learning and Creativity, (b) Design and Develop Digital-Age Learning Experiences and Assessments, (c) Model Digital-Age Work and Learning, (d) Promote and Model Digital Citizenship and Responsibility (e) Engage in Professional Growth and Leadership

NETS-S Standards: (a) Creativity and Innovation, (b) Communication and Collaboration, (c) Research and Information Fluency, (d) Critical Thinking, Problem Solving, and Decision Making, (e) Digital Citizenship

Partnership for 21st Century Skills Set: (a) Core subjects and 21st century themes, (b) Learning and innovation skills, (c) Information, media and technology skills, (d) Life and career skills

Technology and Instructional Practices Demonstrated and/or Used by Participants to Address NETS-T and NETS-S Standards:

Technology demonstrated and/or used by participants during training:

(a) Hardware: flash drives, digital cameras, flip video cameras, Elmo, Turning Point Technology (clickers), InterWrite Boards (Airliners)
(b) Software: Instructional websites, social bookmarking, video communication (Skype & WebEx), wikis and blogs, digital storytelling, video creation

(Premiere), audio creation, distance communications (EPals), photo editing (PhotoShop), virtual learning (Second Life).

Instructional practices demonstrated and/or used by participants:
(a) Grappling's Technology and Learning Spectrum, (b) collaborative grouping, (c) problem-based learning, (d) Bloom's Taxonomy, (e) inquiry-based learning and instruction, (f) advance organizers (KWHL Chart), (g) use of rubrics.

Once these technology tools and instructional practices were demonstrated and/or used, the participants collaborated within their teams to create a one minute video using a problem-based learning scenario. Each team viewed the other teams' videos on the last day. This was their final project for the course.

Fall, 2009 Each team of teachers implemented activities learned from the course in their classrooms. Teachers documented best practices and submitted implementation artifacts. They had continuous support from an expert mentor during the regular school day. Bi-monthly reflections submitted to team blog site.

Bi-monthly Reflections

- Journals should be both descriptive and reflective
- Feedback must be provided to at least one other teacher's journal from teacher's school
- Example questions posed in Wiki for teacher's to reflect upon:
    1. Describe the activities/lessons you have used in the last two weeks that directly relate to the summer instruction that you received.
    2. Where do these activities/lessons fall on the Grappling's Technology and Learning Spectrum? Why?
    3. How does this activity help meet your personal and/or team goals?

Winter, 2009/2010 Two additional days of professional development during the school work day. Teams share best practices learned during classroom implementation and receive leadership and facilitation training to help engage other teachers from their school and promote program. Teachers continue submitting bi-monthly reflections to team blog site. They have continuous support from an expert mentor during the regular school day. $1,000 per team processed for meeting implementation requirements.

Spring, 2010 Showcase student work to entire school staff. Each school receives $500 to fund activity. Teachers recruit four to six additional teachers to participate in the second year of the program. Teachers continue submitting bi-monthly reflections to team blog site. They have continuous support from an expert mentor during the regular school day. Three hours of graduate credit to team teachers at no cost for meeting implementation requirements.

Summer, 2010 Five days of Phase 1 professional development offered to recruited team of teachers from the same school as previous team groups. Five days of Phase 2 professional development offered to original teams. $4,000 given to each participating school to purchase materials/supplies for classroom implementation. $1,000 given as an incentive per team teacher for meeting implementation requirements.

2010/2011 School Year Team teachers continue implementing technology and supporting recruitment teachers. Recruitment teachers implement course activities in their classrooms. They have continuous support from an expert mentor during the regular school day. $500 per team teacher offered for meeting implementation requirements. Three hours of graduate credit to team teachers at no cost for meeting implementation requirements.

Evaluation

Marshall University's Graduate College evaluated this professional course by completing the following tasks:

1. Reviewed proposals, syllabi/objectives, and agendas for academy
2. Developed and analyzed pre/post survey taken by participants about their perceptions of the training
3. Developed an interview protocol and conducted focus groups/interview with participants during follow-up session about their perceptions.
4. Developed evaluation protocol for mentors to use and analyzed data provided
5. Reviewed wikis maintained by participants

Appendix I: LoTi Survey Questions

LoTi Digital-Age Survey: Demographic Questions

1. Which category best describes your primary subject/specialty?
2. How many years of experience do you have in education?
3. What is your age group?
4. What is your highest level of education?
5. How many computers do you have for instructional use in your classroom?
6. Approximately how often do students use computers in your instructional setting?
7. How many hours of technology-related training have you received over the past five years?
8. From which individual(s) do you mostly seek primary guidance, information, inspiration, and/or direction relating to the integration of technology in your instructional setting?
9. What do you perceive as your greatest obstacle to further using technology in your instructional setting?
10. Do you participate in formal or informal technology sharing sessions, such as faculty meetings, inservice training, lunchtime discussions, before or after school meetings, or common preparation time within your instructional setting?

WVA: LoTi Digital-Age Survey for Teachers

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Welcome test!

LoTi Digital-Age Survey

LoTi Digital-Age Survey: Teacher Computer Use

* Required *

How often are you (the teacher) using digital tools and resources during the instructional day?

0	1	2	3	4	5
Never	At least once a year	At least once a month	At least once a week	At least once a day	Multiple times each day

Previous Continue

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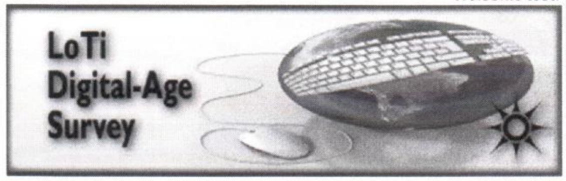

LoTi Digital-Age Survey: Student Computer Use

* Required *

How often are your students using digital tools and resources during the instructional day?

0	1	2	3	4	5
Never	At least once a year	At least once a month	At least once a week	At least once a day	Multiple times each day

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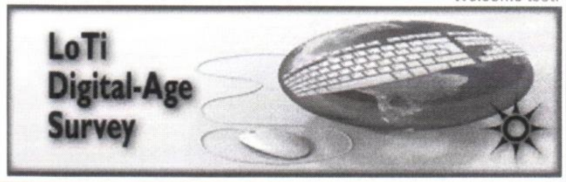

LoTi Digital-Age: Teacher Questions

Question #1

I use digital tools and resources to plan, prepare, present, and/or grade instructional activities rather than allowing students to use the digital tools or resources as part of the instructional day.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #2

I use my school's digital tools and resources exclusively to access the Internet, communicate with colleagues or parents, grade student work and/or plan instructional activities for my students.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #3

My students use all forms of the most advanced digital tools (e.g., digital media authoring tools, graphics programs, probeware with GPS systems, handheld devices) and resources (e.g., publishing software, media production software, advanced web design software) to pursue collaborative problem-solving opportunities surrounding issues of personal and/or social importance.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #4

I engage students in learning activities that require them to analyze information, think creatively, make predictions, and/or draw conclusions using the digital tools (e.g., interactive whiteboard, digital student response system) and resources (e.g., Inspiration/Kidspiration, Excel, InspireData) available in my classroom.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #5

I promote, monitor, and model the ethical use of digital information and technology in my classroom (e.g., appropriate citing of resources, respecting copyright permissions).

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #6

I use different technology systems unique to my grade level or content area (e.g., online courseware, Moodle, WAN/LAN, interactive online curriculum tools) to support student success and innovation in class.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #7

I seek outside help with designing student-centered performance assessments using the available digital tools and resources that involve students transferring what they have learned to a real world context.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #8

I participate in local and global learning communities to explore creative applications of technology to improve student learning.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #9

I employ learner-centered strategies (e.g., communities of inquiry, learning stations/centers) to address the diverse needs of all students using developmentally-appropriate digital tools and resources.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #10

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

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

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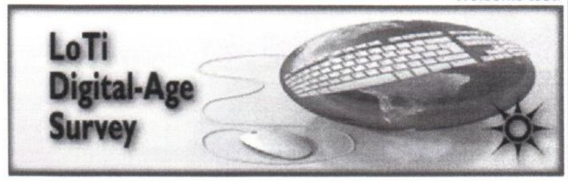

LoTi Digital-Age: Teacher Questions

Question #11

I consider how my students will apply what they have learned in class to the world they live when planning instruction and assessment strategies.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #12

Students in my classroom use the digital tools and resources primarily to create web-based (e.g., web posters, student blogs or wikis, basic webpages) or multimedia presentations (e.g., PowerPoint) that showcase digitally their research (i.e., information gathering) on topics that I assign.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #13

I design and/or implement web-based projects (e.g., WebQuests, web collaborations) in my classroom that emphasize the higher levels of student cognition (e.g., analyzing, evaluating, creating).

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #14

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

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #15

I assign web-based projects (e.g., web collaborations, WebQuests) to my students that emphasize complex thinking strategies (e.g., problem-solving, decision-making, experimental inquiry) aligned to the content standards.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #16

My students discover innovative ways to use our school's advanced digital tools (e.g., digital media authoring tools, graphics programs, probeware with GPS systems) and resources (e.g., publishing software, media production software, advanced web design software) to pursue their individual curiosities and make a difference in their lives and in their community.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #17

I use different digital media and formats (e.g, blogs, online newsletters, online lesson plans, podcasting, digital documents) to communicate information effectively to students, parents, and peers.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #18

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

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #19

I provide multiple and varied formative and summative assessment opportunities that encourage students to "showcase" their content understanding in nontraditional ways.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #20

My students participate in collaborative projects (e.g., Jason Project, GlobalSchoolNet) involving face-to-face and/or virtual environments with students of other cultures that address current problems, issues, and/or themes.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

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LoTi Digital-Age: Teacher Questions

Question #21

My students and I use the digital tools and resources (e.g., interactive whiteboard, digital student response system, online tutorials) primarily to supplement the curriculum and reinforce specific content standards.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #22

Problem-based learning occurs in my classroom because it allows students to use the classroom digital tools and resource higher-order thinking (e.g., analyzing, evaluating, creating) and personal inquiry.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #23

My students use the digital tools and resources in my classroom primarily to increase their content understanding (e.g., digi flipcharts, simulations) or to improve their basic math and literacy skills (e.g., online tutorials, content-specific software).

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #24

I promote the effective use of digital tools and resources on my campus and within my professional community and actively develop the technology skills of others.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #25

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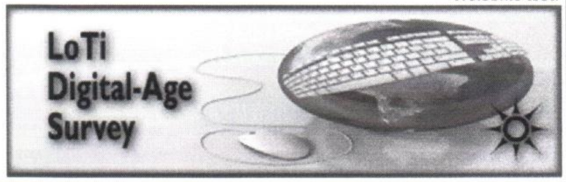
Welcome test!



LoTi Digital-Age: Teacher Questions

Question #31

I model for my students the safe and legal use of digital tools and resources only when I am delivering content and/or reinforcing their understanding of pertinent concepts using multimedia resources (e.g., PowerPoint, Keynote), web-based tools (e.g., Google Presentations), or an interactive whiteboard.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #32

My students use the classroom digital tools and resources to engage in relevant, challenging, self-directed learning experiences that address the content standards.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #33

I model and facilitate the effective use of current and emerging digital tools and resources (e.g., streaming media, wikis, podcasting) to support teaching and learning in my classroom.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #34

My students model the "correct and careful" (e.g., ethical usage, proper digital etiquette, protecting their personal information) use of digital resources and are aware of the consequences regarding their misuse.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #35

My students identify important real world issues or problems (e.g., environmental pollution, elections, health awareness), then use collaborative tools and human resources beyond the school building (e.g., partnerships with business professionals, community groups) to solve them.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #36

I prefer using standards-based instructional units and related student learning experiences recommended by colleagues that emphasize innovative thinking, student use of digital tools and resources, and student relevancy to the real world.

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

Question #37

I continue to offer students learning activities that emphasize the use of digital tools and resources to solve "real-world" problems or issues, even though I experience issues during project implementation (e.g., student discipline problems, network errors, lack of time to plan the lessons, technical glitches.)

0	1	2	3	4	5	6	7
Never	At least once a year	At least once a semester	At least once a month	A few times a month	At least once a week	A few times a week	At least once a day

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Submit Your Survey

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Appendix J: Anonymous Online Survey Consent Form

Marshall University IRB

Approved on:	7/21/09
Expires on:	7/15/10
Study number:	126143

Anonymous Online Survey Consent

You are invited to participate in a research project designed to analyze how the Infusing Technology professional development course influences technology use and integration in your classroom. The study is being conducted by Amy Cottle and Lisa Heaton from Marshall University Graduate College and has been approved by the Marshall University Institutional Review Board (IRB).

This survey is comprised of questions that are based on your experiences with technology integration. It will take approximately 25 minutes to complete. There are no known risks involved with this study. Participation is completely voluntary and there will be no penalty or loss of benefits if you choose not to participate or if you withdraw from this research study. You may choose to skip any question by simply leaving it blank. Completing the online survey indicates your consent for use of the answers you supply.

Survey Instructions for the LoTi Digital-Age Survey:

- Access the LoTi Lounge @ **http://www.lotilounge.com**, click *Login to LoTi Lounge* at the top, then click *Sign Me Up*
- You will be prompted to enter your Group ID and Password.
    - **GroupID:** wva
    - **Password:** wva
- Next, you will be prompted to enter User Information of your choosing. Please WRITE DOWN your User ID and User Password. You will need this information in order to complete a post-survey.
- Follow the on-screen registration instructions. Next, you will be prompted to enter your Email address. This information will not be shared. All of your responses will be reported in aggregate. Individuals will not be identified in any report.
- You will be prompted to select your organization: WV Center for Professional Development and click continue.
- Finally, click Take LoTi Digital-Age Survey to begin.

Results from this survey will be used to help make decisions about technology and professional development needs. If you would like to receive a copy of the results, please send me an email to aecottle@gmail.com, or call me at (304)-415-3367. If you have any questions concerning your rights as a research participant you may contact the Marshall University Office of Research Integrity at (304) 696-4303.

Thank you for participating in this research study.

Amy E. Cottle
Marshall University Graduate Student

Appendix K: Interview Questions

MARSHALL

Marshall University IRB

Approved on:	7/16/09
Expires on:	7/15/10
Study number:	126143

Interview Questions

1. How has the Infusing Technology professional development course had an impact on your teaching (if any)?
2. Has your level of comfort in using changed after participating in the course? If so, how?
3. What were the barriers (if any) to your implementation of the technology you learned in the course?
4. How were you supported in using the technology?
5. What was the technology tool (if any) that you integrated into your classroom the most and how was it used?

Appendix L: Informed Consent to Participate in a Research Study

Informed Consent to Participate in a Research Study

Professional Development Institute, Infusing Technology, and Its Influence on How Teachers Use Technology

Lisa Heaton, PhD, Principal Investigator
Amy Cottle, EdS, MAEd, Co-Investigator

Introduction

You are invited to be in a research study. Research studies are designed to gain scientific knowledge that may help other people in the future. You may or may not receive any benefit from being part of the study. Your participation is voluntary. Please take your time to make your decision, and ask your research investigator or research staff to explain any words or information that you do not understand.

Why Is This Study Being Done?

The purpose of this study is to understand how the professional development, *Infusing Technology,* influenced your use of technology in the classroom.

How Many People Will Take Part In The Study?

About ninety people will take part in this study. A total of ninety-six subjects are the most that would be able to enter the study.

What Is Involved In This Research Study?

You will be asked some questions about how the professional development, Infusing Technology, influenced your use of technology in your classroom.

How Long Will You Be In The Study?

You will be in the study for about nine months.

You can decide to stop participating at any time. If you decide to stop participating in the study we encourage you to talk to the study investigator or study staff as soon as possible.

The study investigator may stop you from taking part in this study at any time if he/she believes it is in your best interest; if you do not follow the study rules; or if the study is stopped.

Subject's Initials ________

What Are The Risks Of The Study?

There are no known risks to those who take part in this study.

Are There Benefits To Taking Part In The Study?

If you agree to take part in this study, there may or may not be direct benefit to you. We hope the information learned from this study will benefit other people in the future. The benefits of participating in this study may be the development of quality technology professional development.

What About Confidentiality?

We will do our best to make sure that your personal information is kept confidential. However, we cannot guarantee absolute confidentiality. Federal law says we must keep your study records private. Nevertheless, under unforeseen and rare circumstances, we may be required by law to allow certain agencies to view your records. Those agencies would include the Marshall University IRB, Office of Research Integrity (ORI) and the federal Office of Human Research Protection (OHRP). This is to make sure that we are protecting your rights and your safety. If we publish the information we learn from this study, you will not be identified by name or in any other way.

What Are The Costs Of Taking Part In This Study?

There are no costs to you for taking part in this study. All the study costs, including any study tests, supplies and procedures related directly to the study, will be paid for by the study.

Will You Be Paid For Participating?

You will receive no payment or other compensation for taking part in this study.

What Are Your Rights As A Research Study Participant?

Taking part in this study is voluntary. You may choose not to take part or you may leave the study at any time. Refusing to participate or leaving the study will not result in any penalty or loss of benefits to which you are entitled. If you decide to stop participating in the study we encourage you to talk to the investigators or study staff first.

Whom Do You Call If You Have Questions Or Problems?

For questions about the study or in the event of a research-related injury, contact the study investigator, Amy Cottle at 304-415-3367. You should also call the investigator if you have a concern or complaint about the research.

For questions about your rights as a research participant, contact the Marshall University IRB#2 Chairman Dr. Stephen Cooper or ORI at (304) 696-4303. You may also call this number if:

Subject's Initials ________

- You have concerns or complaints about the research.
- The research staff cannot be reached.
- You want to talk to someone other than the research staff.

You will be given a signed and dated copy of this consent form.

SIGNATURES

You agree to take part in this study and confirm that you are 18 years of age or older. You have had a chance to ask questions about being in this study and have had those questions answered. By signing this consent form you are not giving up any legal rights to which you are entitled.

____

Subject Name (Printed)

____ _______________

Subject Signature Date

____

Person Obtaining Consent (Printed)

____ _______________

Person Obtaining Consent Signature Date

Subject's Initials ________