ABSTRACT

FROM TECHNOLOGY TEACHER TO TECHNOLOGY INTEGRATION SPECIALIST: PREPARING FOR A PARADIGM SHIFT

Jennifer Lynn Penry Dalrymple, EdD
Department of Curriculum and Instruction
Northern Illinois University, 2017
Dr. Elizabeth Wilkins, Director

This dissertation examines the effectiveness of a professional development program designed specifically to provide foundational knowledge and skills to Technology Teachers in preparation for a transition to a Technology Integration Specialist position. Specifically, it evaluates the Technology Teachers' changes in knowledge and beliefs as a result of the professional development. The program evaluation also looks at the Technology Teachers' perceptions of organizational support and their own abilities to fulfill the Technology Integration Specialist role. All aspects are surveyed prior to and at the conclusion of the professional development program to assess changes. Qualitative data from meeting notes, discussion boards, and classroom observations complement the quantitative data to provide a more thorough understanding, given the small sample size in this study.

The data reflected changes in knowledge but not beliefs after the professional development program. The Technology Teachers' perceptions of support as garnered from the survey showed little change, while the qualitative data from meetings and discussion board contributions revealed other perceptions that were not included in the survey questions. Finally, their perception of their own abilities to perform the responsibilities that would be associated with the Technology Integration Specialist role seemed unaffected by the professional development program. Ultimately, the professional development program only had a noticeable effect on building the Technology Teachers' knowledge and exposing their perceptions of insufficient organizational support.

NORTHERN ILLINOIS UNIVERSITY
DE KALB, ILLINOIS

AUGUST 2017

FROM TECHNOLOGY TEACHER TO TECHNOLOGY INTEGRATION SPECIALIST:

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BY

JENNIFER LYNN PENRY DALRYMPLE

A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE

DOCTOR OF EDUCATION

DEPARTMENT OF CURRICULUM AND INSTRUCTION

Doctoral Director:
Dr. Elizabeth A. Wilkins

ACKNOWLEDGEMENTS

This dissertation may never have seen publication without the unwavering support I received from my Dissertation Chair, Dr. Elizabeth A. Wilkins. Dr. Wilkins always knew how to make sense of things for me. Her ability to explain the complexities of a high-quality dissertation coupled with her calm and assuring demeanor meant the world to me as I spent years writing and revising my work. Her patience and encouragement are the reason I am finishing this endeavor with confidence and a sense of true accomplishment. Dr. Wilkins has been my "rock" to lean on, my cheerleader, my champion. I am forever grateful for her wisdom, her insight, and her perseverance in guiding me to fulfill my dream.

DEDICATION

This dissertation is dedicated to my boys – all three of them.

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LIST OF ACRONYMS

CHAT – Cultural Historical Activity Theory

ISTE – International Society for Technology in Education

ISTE·C – International Society for Technology in Education Standards for Coaches

ISTE·S – International Society for Technology in Education Standards for Students

ISTE·T – International Society for Technology in Education Standards for Teachers

IT – instructional technology

LAT – Learning Activity Types

PD – professional development

PEL – Professional Educator License

PLC – Professional Learning Community

SAMR – Substitution, Augmentation, Modification, Redefinition (Dr. Ruben Puentedura's model of technology integration)

TIS – technology integration specialist

TTPD – tech teacher professional development

UTAUT – Unified Theory of Acceptance and Use of Technology

CHAPTER 1: TECHNOLOGY IN EDUCATION

Introduction

According to the Framework for 21st Century Learning, "today, we live in a technology and media-driven environment, marked by access to an abundance of information, rapid changes in technology tools and the ability to collaborate and make individual contributions on an unprecedented scale" (Partnership for 21st Century Skills, 2011a, p. 2). Using Plair's (2008) broad definition, today's technology includes "computers, handheld devices, and multimedia equipment such as cameras, video projectors, graphic calculators, and voice recorders" (p. 70). Plair suggests that because anything containing a microchip qualifies as technology, it is no longer limited to computers.

Given the "technocentric" (Papert, 1987) world in which we live, adolescents are said to spend over seven and a half hours a day interacting with technology to communicate with friends and family, to complete homework tasks, or to simply entertain themselves (Rideout, Foehr, Roberts, & Henry J. Kaiser Family, F., 2010). They will become the businessmen and women of the future, filling jobs that do not yet exist and creating newer and even better technologies than we can presently imagine. Schools need to make sure that educational technology reaches students in a meaningful way now, in their preparatory years, before college and adulthood begin to place their demands. Unfortunately, technology in schools remains depressingly behind the times despite its obvious importance in today's society (Fullan, 2013).

Technology Integration in Education

Technology integration into the educational system needs immediate attention to prepare our students for the future. Harris (2005) uses a definition of technology integration set forth by Earle in 2002 to explain that

> integrating technology is not about technology – it is primarily about content and effective instructional practices. Technology involves the tools with which we deliver content and implement practices in better ways. Its focus must be on curriculum and learning. Integration is defined not by the amount or type of technology used, but by how and why it is used. (p. 117)

The Partnership for 21st Century Skills (2011c) encourages technology integration in schools as a critical component in preparing students to become informed and functioning members of an increasingly technology rich culture. Students must learn to access, evaluate, use, and manage information. They must both analyze existent media and create their own media products, all through the effective application of technology. The information, media, and technology skills addressed in the framework provide students with what they need as citizens and workers in the 21st century who must possess a full range of "functional and critical thinking skills" (Partnership for 21st Century Skills, 2011b).

Balancing technocentricity with the need for 21st century skills is no easy task. Collins and Halverson (2009) compared education after the Industrial Revolution to the current Information Revolution, identifying that antiquated technologies such as the textbook, blackboard, overhead projector, copy machine, and pencils and paper meet the imperatives of uniformity, didactism, and teacher control of the Industrial Age. Students raised with constant media access no longer have the patience to sit in desks and fill out worksheets or listen to

lectures; they are bored (Fullan, 2013). The Information Revolution requires technologies such as computers, video games, the Internet, and cell phones to meet its imperatives of customization, interaction, and user control. Collins and Halverson further contend that integrating such devices into the curriculum prepares students for the future by teaching them how to access, evaluate, and synthesize information rather than simply consume it.

Unfortunately, technology can be challenging for teachers because it requires them to learn new skills, leave their comfort zones, question their own expertise, and reconceptualize what they may currently consider as a distraction in the classroom (Collins & Halverson, 2009). A variety of barriers to technology integration exist and will be discussed in detail in Chapter 2.

Fullan (2013) acknowledges this current situation as described by Collins and Halverson (2009) and suggests a different outlook for technology integration. Fullan purports that the solution to the educational crisis in the United States is the integration of pedagogy, technology, and change knowledge, three components of what he refers to as the "stratosphere" (p. 1). He advises that in order for change to be successful, it must be enjoyable. For this to happen, teachers (and students) must "learn how to learn for a lifetime of pursuing personal passion, purpose, and fulfillment" (p. 4). This may not be the easiest task to undertake, but Fullan provides four criteria for integrating technology and pedagogy, including making it "irresistibly engaging; elegantly efficient and easy to use; technologically ubiquitous 24/7; and steeped in real-life problem solving" (p. 4). One model that can meet Fullan's criteria is the coaching model in which a specialist works collaboratively with classroom teachers in their classrooms, with their students and curriculum, and during the normal work day. Ultimately, this would be the job of the Technology Integration Specialist (TIS) in Newton District 57, but there is quite a bit of

foundational work to be done in preparation for the shift from Technology Teachers (Tech Teachers) to TIS.

The Tech Teacher Professional Development (TTPD) Program that was examined in my study focused on preparing Tech Teachers to shift from their role as providers of a skills-based technology curriculum to TIS whose responsibility would be to provide job-embedded support by collaborating with classroom teachers to integrate technology with the content and standards of the general curriculum. Luckily, Fullan (2013) acknowledges that even small ambitious goals can lead to change. He proposes that if people are involved in meaningful work, and feel capable while making progress, they become more motivated and ready for new challenges.

Connecting Technology to the Curriculum

Hofer and Harris (2010) point out that the traditional heterogeneous nature of the participants in technology PD has contributed to its generic focus on the technology tools rather than specific curriculum applications. This criticism is the basis for their study of technology PD employing Learning Activity Types (LAT).

Harris and Hofer's (2009) curriculum-specific LAT were part of the foundational knowledge provided in the TTPD that was designed, delivered, and examined as part of my study. Harris and Hofer's LAT provide a guide for teachers in their planning for technology integration and are based on extensive review of curriculum journals, methods texts, and curriculum standards. LAT have been created for several different K-12 content areas with the help of a technological pedagogical content specialist for each curricular area as well as a TIS who worked in a collaborative process with the two authors to provide consistency throughout

the taxonomies. LAT were an integral part of the TTPD curriculum to provide a solid foundation for Tech Teachers who may not have been previously part of teaching all subject areas.

Technology Professional Development

Joyce and Calhoun (2010) make it clear that there is no single professional development (PD) model that best reaches all participants. To achieve successful technology integration, teachers require appropriate PD opportunities that are based on adult learning theory, structured yet flexible, and designed around collaboration and reflection (Borthwick & Pierson, 2008, Danielson, 2007; Guskey, 2000; Joyce & Calhoun, 2010; Richards & Farrell, 2005). Two ways to make the PD more meaningful are to focus on meeting standards and to make it job-embedded and personalized (Joyce & Calhoun). The PD Program for Tech Teachers that occurred in the Spring and early Summer of 2015 modeled the types of responsibilities that TIS would be expected to perform when the TIS Program is implemented. By incorporating modeling and co-planning / co-teaching with the participants in the design of the TTPD, they received the benefit of experiencing what the classroom teachers would experience in the proposed TIS Program.

Job-embedded Technology Integration Support

The International Society for Technology in Education's (ISTE) white paper on Technology, Coaching, and Community (Beglau, et al., 2011) clearly spells out the need for job-embedded PD such as the coaching model to create a "synergistic and powerful PD partnership"(p. 3). The authors suggest that coaching and collaboration lead to increased teacher

confidence and effectiveness. Their research also calls for PD that appeals to a "new digital generation" (p. 3), including designing for younger teachers and social learners by keeping learning in the classrooms where teachers are most comfortable practicing the art of their profession and by employing new methods of virtual learning. This is where coaching and creating a community for learning come into play. The challenge in Newton District 57 was preparing for such a shift and making the transition as smooth as possible for all parties involved. Part of the transitional plan had to be taking the current Tech Teachers employed in the district and providing them with the foundational knowledge and skills as well as a clear system of support to transform their professional identities into that of a TIS using a collaborative model.

Support and Change

Although the organizational support and change in the District may not have been an item on the Tech Teacher PD "syllabus", it was certainly a factor in the postponement of the initiative to move toward the TIS program. Without an organizational structure to provide administrative support in changing the role of the Tech Teacher, the TIS program would have been nothing more than a new name for a continuation of old practices. The Tech Teachers would need to feel they had not only the principal's support but also the district's support in terms of resources and validation of the importance of the new TIS responsibilities. Additionally, the responsibilities would need to have been clearly communicated to the classroom teachers who would have been expected to collaborate with the TIS. As the interactions among all stakeholders change, there would need to be consistent communications and follow-through on procedures at the classroom, building, and district level to contribute to the success of the program.

Professional development for the Tech Teachers was the first of many steps, some concurrent and others progressive, in the process of changing from technology skill-teaching to technology integration.

Problem Statement

Various researchers (Aubusson, Schuck, & Burden, 2009; Desimone, 2009; Harris, et al., 2010; Harris, Mishra, & Koehler, 2009; Hixon & Buckenmeyer, 2009; Martin, et al., 2010; Mishra & Koehler, 2003) confirm that the current state of PD is not leading to effective technology integration. Workshops, lectures, institute days, and e-learning sessions represent the typical formats designed to disseminate as much information as possible to as many teachers as possible without regard for individual differences, learning styles, or content specialization. Mishra and Koehler describe technology related PD as being based on a checklist of skills determined by state technology plans and national standards that do not address a deep understanding of concepts and skills related to technology integration. Harris, et al. (2009) expand upon this problem stating that the technocentric focus of technology PD encourages teachers to concentrate on *what* technology to use to teach rather than *how* to teach with technology. Helping classroom teachers learn *how* to teach with technology is the central message that must be conveyed to the Tech Teachers taking part in the TTPD Program in Newton District 57.

While the status of PD in general is alarming, this study focused on the creation and evaluation of a particular PD program designed with the purpose of imparting knowledge and skills to a set of individuals who would ultimately be changing their daily roles and

responsibilities to improve technology integration in their schools. It was not easy to tell a group of adults that their jobs would be morphing into something that may or may not interest them. It was not easy to design a learning experience tailored to such a specific task. Nonetheless, that was the charge that I took in collaboration with our Instructional Technology Coordinator because we understood the promise of a future for our district's students where technology and instruction are truly and seamlessly integrated.

Purpose Statement

The primary purpose of my research was to assess the effects of the TTPD Program on the knowledge, beliefs, and feelings of preparedness of a group of Tech Teachers. The three components were assessed before and after their participation in a specialized PD program during the Spring and early Summer of 2015. A secondary purpose of my research was to investigate the relationship among the current activity system involving the Tech Teachers as subjects and the activity systems that would exist during and following their participation in the TTPD Program. A final point to consider was the Tech Teachers' perceptions of organizational support within the school and district that would be needed to make the TIS Program a success. All of the data gathered and analyzed as part of this study was intended to inform future PD for the Tech Teachers, district administrators, and even classroom teachers as the district prepared to implement the TIS Program.

Research Questions

My research sought to answer the following questions. The first three questions addressed the evaluation of the TTPD Program. The last question examined the intersystem interactions throughout the process of changing from Tech Teachers to TIS.

1. Did the Spring 2015 TTPD Program change the Tech Teachers' knowledge and beliefs about technology integration?
2. What were the Tech Teachers' perceptions of organizational change and support as the district progressed toward the implementation of a TIS Program?
3. Did the Tech Teachers feel that the TTPD Program provided them with the necessary skills to participate successfully in the TIS Activity System?
4. What are the complementary and contradictory intersystem interactions that manifest during the progression of the Tech Teacher through the three activity systems? (current, during TTPD Program, and TIS implementation system)

Frameworks

The first part of my research focused on the effects of the TTPD Program on three of Guskey's (2000) five levels of evaluation. At level one, I investigated potential changes in the Tech Teachers' knowledge and beliefs about technology integration. Level two took the Tech Teachers' perceptions of organizational change and support into consideration. Additionally, my research examined the Tech Teachers' feelings of preparedness to address their future role as TIS after participating in the program.

Guskey's Five Levels of Evaluation for Professional Development

According to Guskey (2000) there are five levels of evaluation for PD programs.

1. Participants' Reactions
2. Participants' Learning
3. Organization Support and Change
4. Participants' Use of New Knowledge and Skills
5. Student Learning Outcomes

Participants' Reactions

According to Guskey (2000), participants' reactions to PD center on the content, process, and context of the PD experience. Guskey's model was created in 2000 based on the National Staff Development Council's categories of content, process, and product from that time. Guskey's evaluation of level one gathers data on the participants' overall satisfaction with the PD experience, including how they judged the presenter and whether or not the PD seemed like a good use of their time. Since then, however, the National Staff Development Council has not only switched its name to Learning Forward, but also changed its focus to the seven PD standards of Learning Communities, Leadership, Resources, Data, Learning Designs, Implementation, and Outcomes. Although Guskey's first level of evaluation regarding participants' reactions could be adapted to the new PD standards, it was beyond the scope of this research to rewrite Guskey's first level of evaluation and use it to assess the TTPD Program.

Participants' Learning

Evaluation at level two focuses on "measuring the knowledge, skills, and perhaps the attitudes that participants gained" (Guskey, 2000). The measures must be compared to the learning objectives of the PD, and indicators of success should be outlined at the outset of the activity. A pre-assessment can help identify participants who may already have the knowledge and skills and can inform adjustments in content, format, and organization of the activities. My research involved conducting a pre- and post-assessment of knowledge and beliefs. Due to the accelerated timeframe of the TTPD and the corresponding time that I had to perform the evaluation, skills were assessed only at the end of the program through a modified level four evaluation.

Organization Support and Change

At the third level, organization support and change, it was critical to assess the level of support that the Tech Teachers perceived within their individual buildings and in the district as a whole. Guskey (2000) makes special note that such variables can dictate the success or failure of an initiative. The TIS Program proposal clearly delineated requirements at the building and district level that would be required to achieve any level of acceptance and success with the program. There was a section of questions included on the Pre- Post-Survey Instrument that corresponded to Guskey's level three. The questions addressed various sources of tangible and intangible support and would have served as one source of data to inform future policies, job

descriptions, and other protocols that would have been created as the TIS Program was implemented and matured.

Participants' Use of Knowledge and Skills

The fourth level of evaluation traditionally involves gathering data on both the degree and quality of implementation. Because my research was limited to the preparation of the Tech Teachers as they began the shift to the TIS duties, my evaluation at this level was modified. I used a set of "I can" statements to examine the perceptions of preparation of the participants based on the knowledge and skills potentially gained during the TTPD. It was beyond the scope of this research to investigate the actual use of knowledge and skills, so the focus was on the perceived abilities to use them when the TIS program was implemented.

Student Learning Outcomes

While recognizing that improved student learning outcomes is the ultimate goal in the shift from using stand-alone Tech Teachers to having a collaborative TIS program, the scope of the TTPD Program and the examination of its effects did not allow for my study to assess Guskey's (2000) fifth level of evaluation at the time. Because student learning would be tied to all teacher evaluations by 2016, however, it should certainly have been a factor in continued evaluations of the TIS Program.

Examining the outcomes of the TTPD Program was just the first of two purposes for this study. For the second purpose of my research, I relied on the Activity Systems Model to examine the intersystem interactions as Newton District 57 transitioned from Tech Teachers to TIS.

Activity Systems Model

The activity systems model evolved from Cultural Historical Activity Theory (CHAT), a combination of Vygotsky's and Leontiev's work. Leontiev took Vygotsky's idea of mediated action as a process and expanded it from the activity theory perspective to include "a series of processes that is contained within an activity that acts as a bounded system" (Yamagata-Lynch, 2010, p. 20). An activity system includes six interconnected elements and is represented visually by a small inverted triangle housed within a larger triangle. Additional inter-connecting lines illustrate the tensions within the system. See Figure 1. Tensions are necessary to the activity system as they influence the interactions of the elements of the system and can affect the ultimate outcomes of the activity (Yamagata-Lynch).

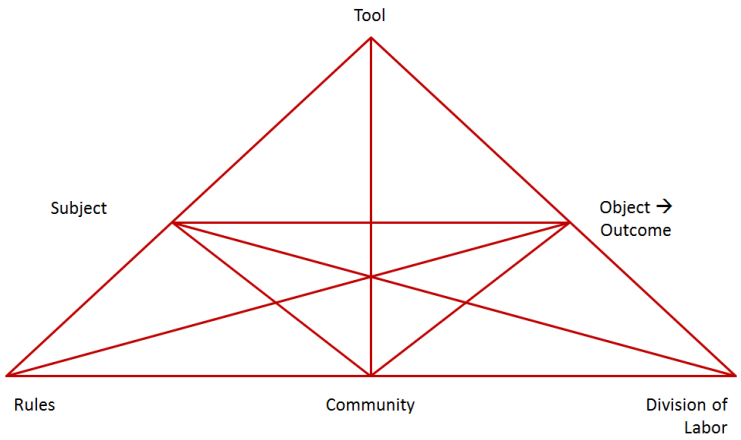

Figure 1. Engeström's Activity System (Yamagata-Lynch, 2010, p. 2)

Third-generation Activity Theory suggests that all activity systems are connected to or a part of other systems in some way (Ball Anthony, 2012). This study investigated the complementary and contradictory interactions of three activity systems: the current reality of instructional technology in Newton District 57, the initiation of the shift to TIS via the TTPD Program, and the proposed TIS Program implementation system. The first activity system represents the current reality of instructional technology (and lack of technology integration) and will overlap with the second activity system during the transitional time of the TTPD Program. The last activity system, however, will replace the first two when the TIS Program is implemented. Figures 2-4 are basic representations of the activity systems in this research.

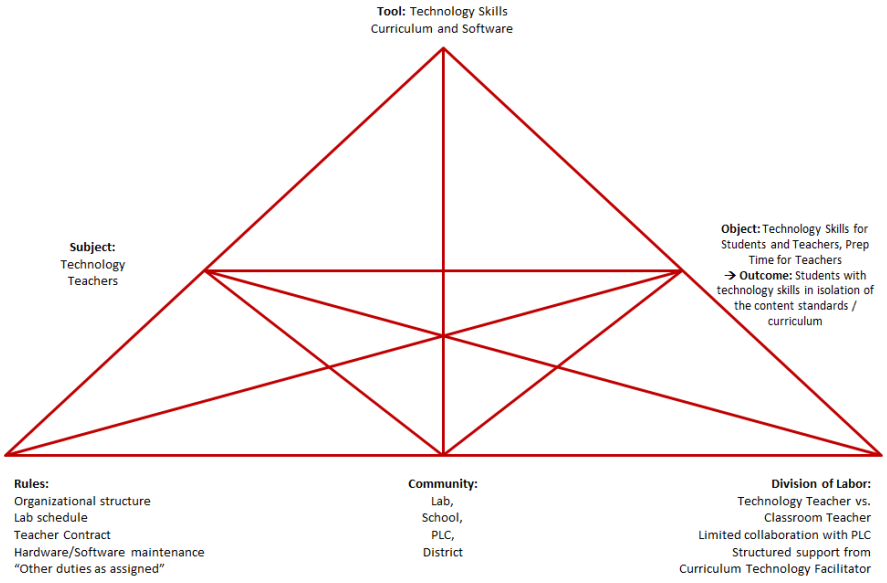

Figure 2. Current Reality of Instructional Technology Activity System

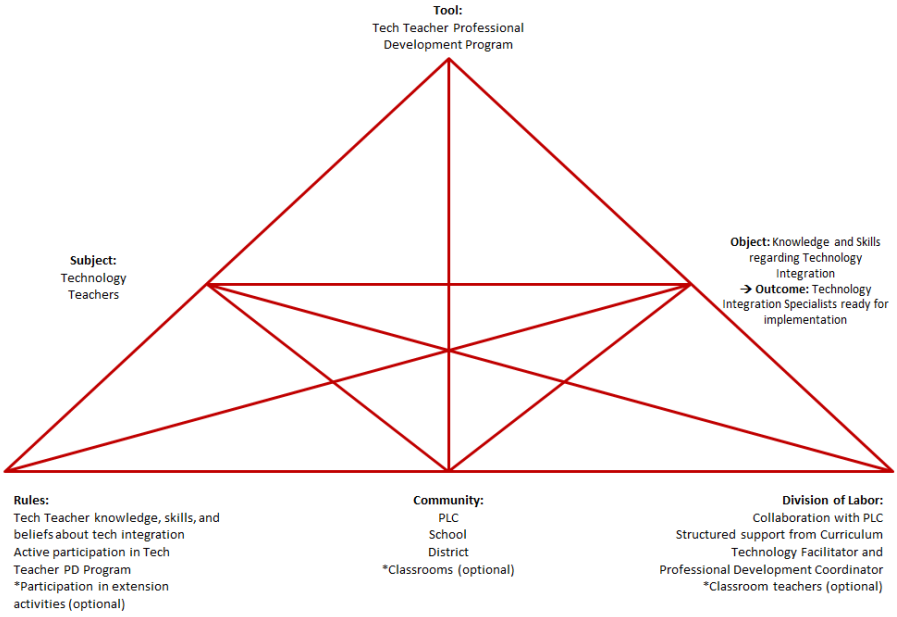

Figure 3. Activity System during Tech Teacher Professional Development Program

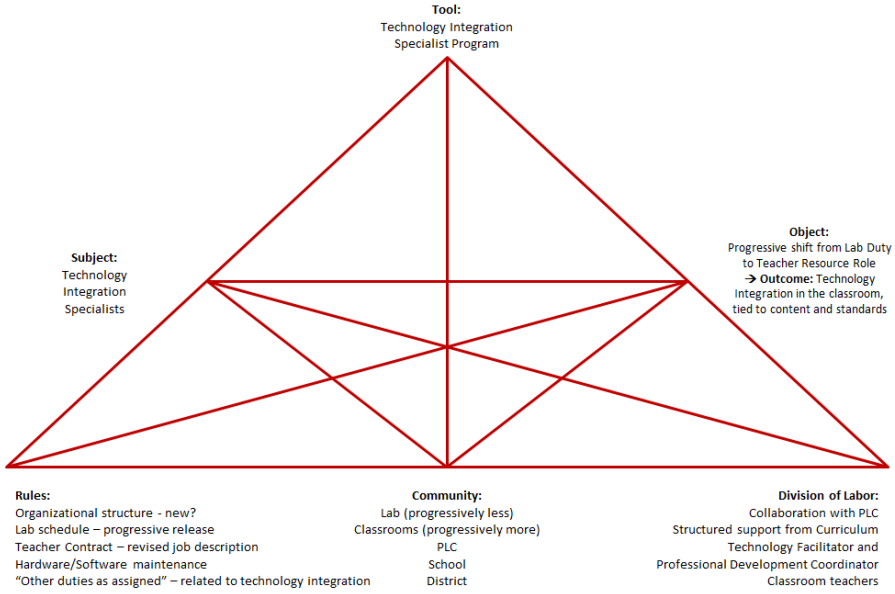

Figure 4. Activity System under the proposed Technology Integration Specialist Program

Each of the frameworks discussed in this section provided a lens particular to one or both of the purposes of my study. Guskey's (2000) five levels of PD evaluation allowed me to examine the TTPD Program in terms of the participants' learning, perceptions of organizational support and change, and the participants' (intended) use of the knowledge and skills potentially gained during the program. The Activity Systems framework gave me a method of looking at how different elements of three different activity systems that exist either concurrently or consecutively had the possibility of both complementary and contradictory interactions.

Significance of the Study

Past research in the field of educational technology integration has focused on PD for the classroom teacher (Borthwick & Pierson, 2008; Desimone, 2009; Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Harris, 2008; Harris & Hofer, 2009; Harris et al., 2010; Harris, et al., 2009; Hixon & Buckenmeyer, 2009; Hofer & Harris, 2010; Hofer & Harris, 2012; Martin et al., 2010; Overbaugh & Lu, 2008; Plair, 2008). More recent research has also studied the influence of LAT on teachers' instructional planning (Harris, et al., 2010). My study complemented the current body of research but took a slightly different perspective. By looking at the shift from Tech Teacher (working primarily with students to deliver a skills-based curriculum) to TIS (acting as a resource to classroom teachers) my in-depth case study scenario shed new light on a part of the paradigm shift that past research has ignored.

Definitions

For the purpose of clarity and consistency, specific terminology in my research included the following:

- 21st century learner: a student who must master core subjects and 21st century themes as a basis for successful critical thinking, problem solving, communication, and collaboration (Partnership for 21st Century Skills, 2011a).
- Activity system: "a series of processes that is contained within an activity that acts as a bounded system" (Yamagata-Lynch, 2010, p. 20). The system includes subject, tool, object/outcome, rules, community, and division of labor.
- Educational technology: any technological tool used for the purposes of teaching and learning whether it is the intended use or a repurposing of the tool.
- Learning Activity Types (LAT): an established set of content-based activities related to the curricular learning goals and aligned with possible technological tools to help accomplish those goals (Harris & Hofer, 2009).
- Technology integration: "the pervasive and productive use of educational technologies for purposes of curriculum-based learning and teaching" (Harris, 2008, p. 252).
- Tech Teacher: In Newton District 57 the Tech Teachers are assigned, one per building, to give classroom teachers prep time while their students attend a skills-based lesson in the computer lab. There is limited other collaboration between the

Tech Teacher and the classroom teacher, mainly focused on administering computerized testing and learning basic software skills.

- Technology Integration Specialist: For the purposes of Newton District 57, a TIS will serve the role of directly collaborating with teachers during their Professional Learning Community (PLC), prep, or classroom time to cooperatively plan lessons, model lessons, or co-teach lessons that integrate technology with the curriculum standards.

Additionally, due to the numerous acronyms that are used throughout the document, a comprehensive list of acronyms and their corresponding phrases is found in the front matter of this dissertation.

Methodology

My research employed a mixed-method design to best address each of the two purposes. By combining basic quantitative data from surveys with a number of qualitative sources from a multiple-case study and an activity system analysis of the overall process, I was able to provide a more complete understanding of both the TTPD Program and the relationships between the activity systems.

Participants included 13 Tech Teachers representing grades K-8 in a PK-12 district. The Tech teachers were diverse in their years of experience in education and had varying skillsets and dispositions for working with both technology and adults. Data were collected from the study participants at various times between December 2014 and June 2015 and included surveys,

discussion board contributions, classroom or PD session observations, document review, and field notes from PD sessions. Survey data were analyzed with basic, descriptive statistics while qualitative data underwent a series of coding levels to create categories and discover themes about the participants' experiences in the program, their intended applications of the knowledge and skills, and any potential changes in beliefs about technology integration. Activity systems analysis was used to support the conclusions of the qualitative data analysis by matching coded data with corresponding elements of the activity systems in question to provide examples of complementary and contradictory intersystem interactions.

Organization of the Study

My study is organized into five chapters. The first chapter introduced the topic of educational technology and the PD necessary to improve technology integration. It provided a description of the problem as well as research questions and the proposed significance of the study. Definitions provided in this chapter facilitated continued reading. The second chapter provides a review of the literature regarding technology integration including a comprehensive examination of model programs and the PD that best supports them. The frameworks that guided my research, Guskey's (2000) Five Levels of PD Evaluation and Activity Systems Theory, are also discussed in greater detail in Chapter 2. Chapter 3 describes the methodology used for my case study as well as the measurement tools employed during the research. Chapter 4 analyzes the results of the surveys and exposes the patterns of feedback from the participants' technology PD experience and plans for subsequent technology integration into the curriculum. The fifth and

final chapter of my study includes implications, recommendations for professional educators, and suggestions for future research.

CHAPTER 2: LITERATURE REVIEW

Introduction

This chapter will examine the current literature regarding technology integration and PD The literature on technology integration will focus on providing a clear definition and identifying usage trends, including barriers to usage. The literature on PD will focus on current practices and suggested practices related to technology PD, including models providing job-embedded options such as coaching. These two broad topics with respective subtopics will provide direction for the overall structure of the chapter. This chapter will also include a description of the TTPD Program and a corresponding model of PD evaluation. Finally, the chapter will conclude with an explanation of Activity Systems Analysis that will be used to examine the interactions among the three systems involving technology integration practices in the district.

Current Reality

The U.S. Department of Education's Office of Educational Technology (2010) tells us in their National Education Technology Plan that there is a gap in technology understanding that "prevents it from being used in ways that would improve instructional practices and learning outcomes" (p. 10). The report urges school systems to act on technology integration with urgency and be flexible to make corrections along the way through a support system including strong leadership, collaboration, and investment at all levels. Although this report refers more holistically to the educational system in the United States, this very message

and the urgency it conveys should be what fuels our district's efforts to improve technology integration.

Adolescents have increasing access to various types of technology for personal use, including cellular phones, tablet computers, MP3 players, digital television programming, etc. They do not have anyone teaching them how to use these technologies; they simply figure them out because they are motivated to do so. Students, however, are not as motivated to be autodidacts when it comes to academic technologies like digital storyboards, blogs, wikis, and digital video production among others. Students need a teacher who is well-versed in technology to be a model and a leader for them when it comes to applying technology skills to academic practices. The skillset including "information, media, and technology" is just one of the many addressed by the Partnership for 21st Century Learning in its framework. The history of the Partnership for 21st Century Learning tells us that rapidly changing technologies and the globalization of the world's economy are strong indicators that teachers need to do a better job of making sure they prepare all students for a successful future.

Students are not the only ones who need help in learning about technology applications in the classroom environment. Teachers are experimenting more and more with technology in their personal lives with smart phones, Facebook accounts, digital video recording, and more. Unfortunately, So and Kim (2009) point out that just because teachers know how to apply technology for personal uses, it does not mean that they know how to use technology for educational purposes. Teachers, like students, may need an extra push to transition from personal use of technology to classroom technology integration. Because the content and context of learning has forever changed with technology, teachers need PD that will allow them to fill the "profound gap between the knowledge and skills most students learn in school and the

knowledge and skills they need in typical 21st century communities and workplaces" (Our mission, "Twenty-first Century Children," para. 2).

Technology has the potential to personalize the learning process, extend learning beyond the school day, improve the quality of instructional materials, and ultimately, "prepare today's students to thrive and compete in the increasingly global information economy" (Project Tomorrow Speak Up & Blackboard K-12, 2013). The numerous barriers that teachers encounter when considering technology integration and the current state of PD are two of the main reasons that, despite the obvious importance of technology in today's society, technology in schools remains depressingly behind the times. To begin, it is important to look at what constitutes technology integration, trends in current practices, and suggested best practices.

Technology Integration

As referenced in Chapter One, technology can include a variety of hardware and software, including, but not limited to computers, laptops, tablets, video cameras, smart phones, video projectors, voice recorders, interactive white boards, and the list goes on. To remain consistent with the definition of technology integration for my study, I repeat here the definition Harris (2005) uses as set forth by Earle in 2002:

> Integrating technology is not about technology – it is primarily about content and effective instructional practices. Technology involves the tools with which we deliver content and implement practices in better ways. Its focus must be on curriculum and learning. Integration is defined not by the amount or type of technology used, but by how and why it is used. (p. 117)

Overbay, Mollette, and Vasu (2011) extend Earle's idea of technology integration by further stating that initiatives to integrate technology are not about the technology itself, but rather about the people expected to use it. Researchers have reinforced the idea that the mere presence of technology does not equate integration, or even use (Hofer, Chamberlin, & Scot, 2004; Overbay, Mollette, & Vasu, 2011; Wilson, Notar, & Yunker, 2003) and report that the financial investment in equipment far outweighs the investment of time or monetary resources in PD devoted to using the technology (Sangrà & González-Sanmamed, 2010). With the potential to engage students, compel them to learn, energize teaching, and allow student-centric, relevant, and rigorous learning experiences (Vockley, n.d.), current trends revealed in the research on technology use in education are hard to believe.

Technology Usage Trends

Measuring the use of technology in education is surprisingly difficult. Schools have been investing in increasing the physical technology resources available, but not focusing on changing teaching practices (Sangrà & González-Sanmamed, 2010). Taking inventory of the number of devices available, describing the type of hardware, software, and web-based programming to which students and teachers have access is relatively straightforward. The National Educational Technology Plan (2010) demands that we do more than just take inventory – we must collect data on technology usage. Vockley (n.d.) reminds us that the educational sector is dead last when considering technology use. The data that have been collected over the last decade reveal three trends in the type of information available on technology integration. First, the research tells us little about student use of technology in the classroom. Second, the research shows us that some

teachers are using technology, but what is important to consider is *how* they are using technology. Lastly, the research exposes negative school and district-level reactions to technology. The former is the first consideration in this section of the literature review.

Student Use of Technology

Overall, studies have shown that student use of technology in education remains stagnant (Means, 2010; Vockley, n.d.). Although comparable uses have been found at the elementary and middle school levels (Bebell, Russell, & O'Dwyer, 2004), it must be noted that using technology in a student-centered, constructivist way is a "daunting challenge for many classroom teachers" (Wilson, Notar, & Yunker, 2003 p. 1). When looking at the types of technology integration being used in schools, Halverson and Smith (2009-2010) point out that when K-12 schools integrate technologies for learners, it is in the context of meeting pre-determined learner goals that are not in control of the learner. It is refreshing to know that, even if students are not using technology within the classroom for all that it can offer them, 50% of students do report using technology, especially social media, outside of the classroom for educational purposes. A possible explanation for the students' lack of technology use in the classroom may be directly related to the teachers' use of technology integration.

Teacher Use of Technology

According to Halverson and Smith (2009-2010), Papert knew the teacher role would have to change even in 1980, but unfortunately, access to technology has not led to change in teacher

practices, at least not on a wide scale. Wilson, Notar, and Yunker (2003) cite a general lack of use leading to criticism of American public schools for not tapping into available technology resources to deliver instruction. They provide us with statistics including statements that

> less than two of every 10 teachers are serious users of computers in their classrooms (several times a week). Three to four are occasional users (about once a month). The rest—four to five teachers of every 10 teachers—never use the machines for instruction. (p. 1)

Bebell, Russell, and O'Dwyer (2004) found that teachers who do not use technology personally do not ask their students to use technology. In their study that uses multiple measures to get a more accurate picture of technology use by considering not only *what* Tech Teachers use, but *how* they use it, they found that teachers, like students, are using technology outside of the classroom. The most obvious trend in teacher use of technology is the favoring of technology for productivity tasks and basic communications such as email (Bebell, Russell, & O'Dwyer, 2004; Means, 2010; Project Tomorrow, 2013). An alarming finding in the research is that educators are purposely holding out on technology integration until they see a direct payoff in student learning outcomes (Borthwick & Risberg, 2008; Means, 2010). Although this phenomenon clearly relates to the teacher change model, Means points out that there are only a "few articles out there that document a correlation between an implementation practice and student learning outcomes" (p. 287). There is an apparent paradox in the logic because the teachers cannot see results in student learning linked to technology if teachers refuse to use technology. The teachers' resistance could be related to the reactions to technology that they have seen coming from their school or district level leadership.

School and District Reactions to Technology

While it seems that many schools and districts have followed suit with providing physical technological resources to their staff, and even in their buildings, uses of technology, including those associated with students' own devices, have caused some negative reactions from administrators. Some traditionalists see technology as a threat to classroom order, teacher authority, and [their] traditional position at the front of the classroom (Wehrli, 2009). As a result, they ban, ignore, or limit technology use rather than embracing its potential to enhance teaching and learning practices and restructure the educational process (Halverson & Smith, 2009-2010; Johnson, 2010). Halverson and Smith do report on other districts, however, that opt for using technology in the most basic sense, to substitute it for existing practices, including a few computers in the back of a classroom that are restricted for specific uses.

All told, the research gives us a very bleak picture of technology use in education. Between student use, teacher use, and administrative reactions to technology, there is still quite a way to go if we are to incorporate technology in every aspect of education. One of the first steps that we can take is to understand the barriers that teachers face when considering technology integration and look for possible solutions.

Barriers to Usage

The work of many researchers (Ertmer, 1999; Overbaugh & Lu, 2009, Tsai & Chai, 2012) reveals clear patterns regarding barriers to technology integration. Some go into great detail about the nature of the barriers (Ertmer, 1999; Overbaugh & Lu, 2009, Tsai & Chai, 2012)

and others offer suggestions to overcome them (Ertmer, 1999, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer, Ottenbreit-Leftwich, & York, 2007; Hew & Brush, 2007; Park & Ertmer, 2007). By tracing the research on these barriers, it becomes clear that there are issues that are out of the control of the teacher or district. One barrier that *is* controllable is the PD provided in an effort to incorporate technology into the curriculum and the everyday practices of teachers. Looking at the barriers, and specifically at technology PD (as discussed later in this chapter), reveals a cycle of failure in the attempt to meaningfully integrate technology into education. PD for teachers usually has a negative evaluation in its current format (Harris, Mishra, & Koehler, 2009; Matzen & Edmunds, 2007; Mishra & Koehler, 2006, 2003; Plair, 2008). This literature review identifies the myriad of barriers attached to technology integration and the inadequate technology-related PD, which were found to be the most prevalent themes surrounding technology integration.

Bingimlas (2009) and Hew and Brush (2007) provided reviews of the current literature regarding barriers, including the work of seminal authors like Ertmer (1999) as well as many other more contemporary researchers and their studies. Bingimlas examines the barrier classifications created by Al-Alwani (2005), Balanskat, Blamire and Kefala (2006), Ertmer (1999), and Pelgrum (2001) to neatly organize a synthesis of their work into "teacher-level barriers" and "school-level barriers." According to Bingimlas, teacher-level barriers include lack of teacher confidence, lack of teacher competence, resistance to change, and negative attitudes. School-level barriers involve lack of time, lack of effective training, lack of accessibility, and lack of technical support. Though the author's fusion of barrier types formed by his literature review seems logical and refined, the article itself does not provide sufficient information regarding the selection of articles to review, only stating that the focus was on present and future

barriers that may be faced by science teachers. This narrow focus also leads the author to acknowledge the limitation of his review and resulting barrier categorizations in that they do not include less direct but still important barriers such as "lack of classroom management skills, poor administrative support, poor school funding, and poor fit with the curriculum" (p. 243).

Another review of the literature performed by Hew and Brush (2007) has a much wider scope for its research base. The authors of this review analyzed empirical studies from 1995 to spring 2006 with a general focus on identifying barriers to technology integration. After distinguishing 123 barriers, they classified them into six main categories based on the frequency with which they were mentioned in the studies. The categories, including resources, knowledge and skills, institution, attitudes and beliefs, assessment, and subject culture were then explained in great detail with subcategories and examples of each. The authors then provided a description of the relationships among the barriers and an extremely detailed and thoroughly cited diagram as a visual representation of their model. It is through the establishment of these relationships that Hew and Brush arrived at their final classifications of barriers into those that directly and indirectly influence technology integration. The authors found teachers' attitudes and beliefs, teachers' knowledge and skills, the institution, and resources to be directly influential on technology integration while subject culture and assessment were indirect influences. This review does not stop at identifying and classifying barriers; it also discusses in great detail strategies for overcoming each of the barrier types as well as recommendations for future studies. Overall, this review of the literature on barriers to technology integration is the more comprehensive of the two, but it still does not provide first-hand data that can be found in the works of authors who have completed their own research.

Seminal author Ertmer (1999) and current researchers Overbaugh and Lu (2008) have identified the barriers that teachers face when considering technology integration. Although Ertmer's seminal article is not a research report, it draws on results from a series of studies in which Ertmer was one of the researchers examining *how* and *why* teachers use technology. The historical background and definition of technology integration that the author provides lend credibility to the discussion of what she classifies as first- and second-order barriers. Her discussion of the relationship between the two barrier types and strategies for addressing the barriers rounds out a well-organized and thoughtfully worded article. Ertmer expands on this work in future articles (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Park & Ertmer, 2007) to provide more depth to her classifications and examples. The first-order barriers, which she contends are extrinsic to teachers, include resources such as computers, software, planning time, and administrative support, or the access to these elements. Additionally, Ertmer considers school and subject culture to fit into the category of first-order barriers. As for second-order barriers, Ertmer lists teachers' pedagogical beliefs about instructional technology, their technology knowledge and skills, their preferred teaching methodologies, their willingness to make changes to classroom practices, and their feelings of self-efficacy. Ertmer's work is comprehensive and is cited by many as a principal contributor to this field of study.

Two other authors have collaborated to offer their classification of barriers to technology integration as well. Overbaugh and Lu (2009) present their interpretation of external and internal barriers and also discuss the interaction of the two types. Overbaugh and Lu also deem external barriers to be extrinsic to teachers and to incorporate such issues as access to resources, time, training, technical support, leadership and social and work environment. Their category of internal barriers is comprised of teachers' beliefs about the value of technology, teachers'

abilities, teachers' attitudes, and teachers' motivations toward change. Their data, based on a grant-funded ongoing PD program, allowed them to discover the current state of technology integration in mid- and southeastern area of Virginia where their study was conducted. Although the limited scope of this research is a consideration in the global application of their findings, the external and internal categories identified are consistent with other sources and make a sensible contribution to the literature base regarding barriers to technology integration.

Due to the variety of terms and descriptions used to refer to barriers to technology integration, Table 1 summarizes the findings in both the literature reviews and the independent research used to complete the literature review contained in this chapter. For clarity and consistency in later sections, Ertmer's (1999) terms first- and second-order barriers will be used throughout this paper unless other, more specific terminology is required by the context.

Even knowing all the barriers that teachers face, if we agree with Vockley (n.d.) that "in a digital world, no organization can achieve results without incorporating technology into every aspect of its every day practices" (p. 2), PD can be a good place to start when attempting to eliminate barriers to integration.

Table 1

Summary Chart of Barriers to Technology Integration

Publication	Barrier categories	Barrier details
	Literature reviews	
Bingimlas, 2009	Teacher-level	1. Lack of teacher confidence 2. Lack of teacher competence 3. Resistance to change and negative attitudes
	School-level	1. Lack of time 2. Lack of effective training 3. Lack of accessibility 4. Lack of technical support
Hew & Brush, 2007	Direct influences:	1. Attitudes and beliefs 2. Knowledge and skills 3. The institution 4. Resources
	Indirect influences:	1. Subject culture 2. Assessment
	Original research	
Ertmer, 1999; Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Park & Ertmer 2007	First-order barriers: (extrinsic to teachers)	1. Resources / Access a. Computers b. Software c. Planning time d. Administrative support 2. School / Subject culture
	Second-order barriers: (intrinsic to teachers)	1. Teachers' pedagogical beliefs a. Instructional technology b. Preferred teaching methodologies c. Willingness to make changes to classroom practices d. Self-efficacy 2. Teachers' knowledge and skills
Overbaugh & Lu, 2008; Overbaugh & Lu, 2009;	External	1. Access to resources 2. Time 3. Training 4. Technical support 5. Leadership 6. Social and work environment
	Internal	1. Teachers' beliefs about / value of technology 2. Teachers' abilities 3. Teachers' attitudes 4. Teachers' motivations toward change

Technology-Related Professional Development

Many articles that centered on the barriers to technology integration also incorporated suggestions for overcoming the barriers (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Hew & Brush, 2007; Overbaugh & Lu, 2008). Meaningful PD for teachers is always a topic of debate, but when the PD involves training teachers in technology with the end-goal of technology integration into the curriculum, the consensus is that there is an overwhelming need for improvement. PD is essential for teachers to make the most effective instructional use of new technologies for teaching and learning, but current offerings provide an insufficient number of hours of PD to make a change in practice (Lawless & Pellegrino, 2007). The Project Tomorrow Speak Up 2013 National Findings report informs us that PD has the biggest impact on student improvement, but 33% of teachers still express a need for more technology PD.

It is probably an obvious statement that PD should be "more than a training, workshop, or listserv; teachers need continual support" (Fox, 2007, p. 36), especially if change in practice is the ultimate goal (Pierson & Borthwick, 2010). The Project Tomorrow Speak Up 2013 National Findings also point out that even teachers who are self-proclaimed "advanced users" of technology have a PD wish list to help them improve their practices. The main problems with the current state of technology related PD center on content, time, context, and format.

Current Practices in Technology Professional Development

As indicated in the barriers section, current practices in technology PD are less than desirable. The four main issues with technology PD are its content, time requirements, context,

and delivery format. The most serious of the offenses of current PD is its "technocentrism." Harris (2005) employs the term originated by Papert in 1987 to refer to the idea that current PD is too focused on specific technologies. This focus on specific technologies leads to PD that is quickly outdated (Mishra & Koehler, 2003). Harris et al. (2010) offer another suggestion with their "learning activity types" (LAT) that match content specific learning activities with appropriate technological formats or supports. If LAT are the focus of the content of technology PD, teachers may feel the time spent learning about and implementing technology integration practices will be time well spent.

All professionals are busy people with business, family, education, and many other commitments that reinforce the cliché of time being a precious commodity. Teacher contracts exist to ensure that professional educators' time is maximized and focused on teaching and learning activities. However, many teachers are expected to either attend PD that is provided outside contract hours with no compensation or participate in PD during the school day which takes them away from their students. Neither of these options is particularly attractive, but there are still other time considerations such as the length of the training program. As with many changes that require a significant modification to beliefs and practices, Brinkerhoff (2006) acknowledges that the transition for teachers from beginning technology use to effective technology integration may take from three to five years. Beyond the time it takes to make this substantial change in practice, the context of the PD plays a significant role in technology integration.

The context of the PD refers to its intended outcomes. Hixon and Buckenmeyer (2009) cite Cuban's (2001) work stating that teachers are merely learning new technologies to help them sustain old practices. Harris (2005) echoes this notion, citing the "mismatch between education

technology leaders' visions and how most practitioners use digital tools" (p. 120). When PD focuses on first-order barriers such as specific software knowledge and skills, second-order barriers are reinforced and emphasized (Hixon & Buckenmeyer, 2009). Harris et al. (2010) highlight the fact that PD that does not address technology, pedagogy, and content as interrelated domains does not lead to effective teaching with technology. Mishra and Koehler (2003) describe current technology related PD as being based on a checklist of skills determined by state technology plans and national standards that do not address a deep understanding of concepts and skills related to technology integration. Together, these authors confirm that the current context of PD is not leading to effective technology integration. If the context of the PD can be appropriately aligned, the format will also be affected.

Workshops, lectures, institute days, and e-learning sessions represent the typical formats of technology PD offerings that are considered ineffective. The training sessions are designed to disseminate as much information as possible to as many teachers as possible without regard for individual differences, learning styles, or content specialization. Another aspect of the format is the use of follow-up training or reflections to create a sense of both support and accountability. Because "traditional sit-and-get-training sessions without follow-up support have proven ineffective in impacting teachers' technology integration," (Brinkerhoff, 2006, p. 23) it is critical to implement and maintain meaningful follow-up to PD to help ensure a positive return on the resources invested. Short-term PD that does not offer continued support is simply ineffective (Matzen & Edmunds, 2007; Plair, 2008). The more formats that are available and the more consistent the use of follow-up, the more teachers are likely to receive the type of instruction they require to make the changes in practice necessary to integrate technology.

Suggested Practices for Technology Professional Development

While research shows us that the problems with current practices center on content, time, context, and format, we learn that suggested practices focus on solutions to those very issues, making culture and format priority considerations. Pierson and Borthwick (2010) bring us back to the very definition of technology integration by reminding us to focus on teachers' technology needs, not the technology itself. They suggest that creating a climate of trust, collaboration, and professionalism that promotes risk-taking is the first step in making technology integration a reality in schools. Mouza (2009) found that technology related PD has to be a commitment by the building and/or district so that teachers know they will continue to be supported in their career-long learning through a sustained PD program. Once the culture begins to manifest itself, the delivery of the PD must be taken into consideration.

There are many researchers who will make general statements about the format of PD based on their research findings. These general statements include touting the importance of a systematic integration approach that incorporates learning, practice, feedback, and continued development (Efaw, 2005), the importance of PD that reflects the setting where teachers work and embraces the students that they teach (Murphy & Lebans, 2009), and the importance of PD that models the desired practices of its participants, in this case, using technology for the delivery itself (Efaw, 2005; Kopcha, 2010; Mouza, 2009; Murphy & Lebans, 2009). No matter the general statement that researchers report, they all align with the use of a collaborative PD model.

Job-embedded Technology Professional Development

When looking at job-embedded PD for technology, the combination of a collaborative community with coaching or mentoring and opportunities for peer observations seems to have the most powerful potential for achieving technology integration. Overbay, et al. (2011) indicate that "collaboration has a very real place in schools implementing a technology initiative" (p. 58) They are supported by Murphy and Lebans (2009), who endorse a job-embedded, collaborative community and Bradburn (2004), who shares his findings about the importance of high teacher support and a collaborative environment. Glazer, Hannafin, Polly, and Rich (2009) promote just-in-time support in a collaborative model to help counter teachers' lack of ability to transfer knowledge from training to the classroom environment. All of these statements about the need for a collaborative learning community are reinforced with calls for mentoring or coaching and opportunities to work closely with peers, especially in terms of observations.

The National Educational Technology Trends report (SEDTA, 2011) calls for communities of practice including coaches or mentors as a supplement to workshops or conferences as a way to provide ongoing support for teacher growth. Efaw (2005) and Pierson and Borthwick (2010) promote mentorship, observation, and sharing forums, and Brinkerhoff (2006) expresses the need for teachers to have time to explore and work with peers on technology use. Even new teachers coming from technology enhanced preparation programs voice their desire to be a part of a mentoring program that will help them implement technology in the classroom (PTSUNF, 2013). Ongoing PD efforts in a collaborative community with mentoring or coaching include collaborative lesson planning and more follow-up opportunities (Mouza, 2009), either through professional learning communities or mentoring programs

(Vockley, n.d.). The clear buzz words generated by research are “collaboration,” “mentor” or “coach,” and “observation.” These words encompass what a TIS program provides.

Technology Integration Specialist Programs. Based on the findings of a previous study of teacher interactions with media coordinators, Bradburn (2004) suggests that high collaboration between a classroom teacher and a TIS will lead to higher student achievement. “Assisting teachers in the classroom as they gain the confidence and skills needed to be successful in sustaining new practices is a critical element in the integration process” and requires a paradigm shift to more of a “personal trainer” method (Owens, 2009, p. 14). The research indicates that there are several common components to a TIS program.

Generally, TIS programs include a coach or specialist who has been trained in technology integration practices and works directly with the classroom teacher to tailor PD to meet individual teacher adoption needs (Kopcha, 2010). Brinkerhoff (2006) makes it clear that the accessibility of the technology support staff must include geographical and scheduling considerations. The state of Virginia has passed state-approved funding for one TIS for every 1000 students (Coffman, 2009), but, according to Hofer, Chamberlin, and Scot (2004), only 16% of schools in the nation are using this model despite its clear advantages. In addition to working directly with classroom teachers to provide technical and pedagogical support (Hofer, et al.), a TIS is expected to partner with the Instructional Technology (IT) staff in the building and report to the building principal regarding what to look for when observing technology in the classroom (Coffman, 2009). Finally, a TIS provides modeling of lessons (Kopcha, 2010) and strategies for classroom management when using technology (Means, 2010). Tailored PD at a convenient time and location that includes various levels of support (technological, pedagogical, and administrative) is what a TIS can offer.

With all of the possible responsibilities of a TIS and the promise of hope this type of program brings, it is also important to note the limitations of this position. Especially when considering the administrative support that a TIS can offering by making sure the principal or other evaluators know what to look for, Ball Anthony (2012) communicates the clear need for effective school leadership. As an advocate for teachers, a TIS has limited authority to mandate technology integration, and information provided to administrators about progress toward technology integration should never include names or practices of specific teachers. Clear identification of the role of the TIS needs to be the first consideration in training teachers or media specialists to fulfill the new role to ensure they have the necessary people skills in addition to their educational technology expertise (Hofer, et al., 2004).

Technology PD is not effective in its current "technocentric" content, time requirements, contexts, and formats. There is hope, however, for positive changes when considering models that include job-embedded collaboration such as using a technology coach or specialist to guide teachers to successful technology integration. My research in evaluating the TTPD Program and the intersystem interactions between activity systems before, during, and after the PD required strong frameworks to guide the investigation.

Frameworks

My research served two purposes and thus required two frameworks. Guskey's (2000) model of the Five Critical Levels of Professional Development Evaluation allowed me to assess the TTPD Program in relation to its intended outcomes. Activity Systems Analysis will be used to identify complementary and contradictory interactions between the three activity systems that

occur over the course of the study. I will address the literature regarding Guskey's PD evaluation framework by first recognizing his Four Key Principles of PD. Subsequent sections will focus on the literature about Activity Systems Analysis.

Guskey's Four Key Principles of Professional Development

Although Guskey (2000) recognizes a variety of models of PD that are appropriate to accomplish an array of objectives, he does find enough commonality to reduce effectiveness of PD to four key principles. First, there must be a clear focus on learning and learners. The learning and the learners in the case of the TTPD Program were actually the classroom teachers with whom the Tech Teachers would work to co-plan, model, and co-teach technology integrated lessons. The Tech Teachers may be indirectly motivated by the students who will ultimately reap the benefits of this collaborative work.

I combine the second and third principles to state (2) there must be an emphasis on individual and organizational change, including (3) small changes guided by a grand vision. The tailoring of the TTPD Program based on a pre-assessment of the Tech Teachers' knowledge and beliefs about technology integration provides the emphasis on individual learning, as will the personalized observations of their collaboration with classroom teachers as formative and summative measures of the application of the TTPD curriculum. The organizational change is being addressed at the building level by providing principals with suggestions for supporting the Tech Teachers in their new collaborative efforts. At the district level, organizational change is supported by gathering evidence of the strengths and weaknesses of the program and its potential for further use in the remaining buildings. The small changes initiated with the TTPD Program

are a small part of a more elaborate 3-year plan to phase in full TIS implementation in the K-8 buildings.

Guskey's last principle states that the ongoing PD must be procedurally embedded. By using established PLC time and allowing the Tech Teachers to be pulled from their lab duties on several planned occasions, there is no obligation for the Tech Teachers to work outside of their contractual hours. Additionally, should there be a new Tech Teacher added to the group at any point, the expectation would be that the new Tech Teacher either be already prepared for the TIS role or complete the same TTPD program in an individualized format.

The alignment of the TTPD Program with Guskey's (2000) Four Key Principles of Professional Development will facilitate the evaluation process using Guskey's Five Critical Levels of Professional Development Evaluation. Understanding Guskey's Four Key Principles of Professional Development is critical, as they are the foundation for his model of evaluating PD.

Guskey's Five Critical Levels of Professional Development Evaluation

Alignment of the TTPD Program with Guskey's (2000) Four Key Principles for PD proved to be advantageous when it came time to evaluate the program. The purpose of the TTPD evaluation was summative in nature. Once the program was completed, it needed to be evaluated for its effectiveness in contributing Tech Teachers who are prepared to take on the TIS role. The results of the evaluation would help the district administration make critical decisions about the implementation of the TIS program and the need to research similar options for the remaining buildings in the district. The data collected during the evaluation of the program could serve as

evidence for the school board that staffing numbers may require reconsideration, or that funding should be made available to help support the implementation of the TIS program.

Although I will explain all five of Guskey's (2000) levels of PD evaluation for the purpose of this literature review, my study only officially evaluated levels 2, 3, and 4 for reasons explained in Chapter One. The five levels of PD evaluation in Guskey's model are: (1) Participants' Reactions, (2) Participants' Learning, (3) Organization Support and Change, (4) Participants' Use of New Knowledge and Skills, and (5) Student Learning Outcomes. Each level measures a specific outcome of the PD with certain questions to address and suggested methods of gathering and using data.

Level One – Participants' Reactions

Level One measures the participants' overall satisfaction with the PD experience. Questions regarding the participants' judgments of the content, process, and context of the event ask them if they liked it, thought it was time well-spent, and found it to be worthwhile. Content questions refer to subject area or grade level as well as general pedagogical practices. Process questions ask about how things were done and focus on program leaders and specific activities. The structure and format of the activities and how well they helped the participant learn the intended material are considered in process questions. Process questions address meeting the basic human needs of participants helps them be more receptive to learning and should be incorporated for all contexts.

The information about participants' reactions to PD is typically gathered through questionnaires involving multiple choice, rating scale, or open-ended type questions given to the

participants with 10 to 15 minutes left of the PD event. The PD facilitator or presenter usually leaves the room to provide participants the opportunity to be open and honest with their answers, especially when responding to questions that ask for suggestions for improvement.

Level Two – Participants' Learning

PD should do more than simply make the participants happy. It should be a true learning experience that enhances the knowledge and skills of teachers that will, in turn, improve student learning outcomes (Guskey, 2000). Level two evaluation seeks to determine if any change has occurred in participants' knowledge, skills, attitudes, or beliefs by answering the general question "Did participants acquire the intended learning goals?"

Despite the importance of the learning that takes place in PD, this level of evaluation is not as common as level one. By evaluating participants' learning, we can establish a relationship between the PD objectives and the actual learning that was achieved. Additionally, we can identify any errors in understanding that may require correction through follow-up activities. Data about the participants' learning allow us to judge the effectiveness of the PD and, in some cases justify its funding. The last, and potentially most important reason to evaluate at level two is that the data about participants' learning will tie directly into implementation efforts.

Multiple question types, such as rating scales and open-ended questions are appropriate to measure participant learning and combining question types is encouraged in order to obtain more varied and rich data. Other options for collecting rich data are interviews, personal learning logs, and case studies. As with all evaluations, participants should be informed from the very beginning what will be assessed following their participation in the activity or program.

Level two evaluation may involve a pre- and posttest to determine change and the attainment of learning goals. Once again in the simple format of a structured response questionnaire, this assessment is given at the beginning of the PD to gather baseline data regarding the participants' point of entry into the activity or program and again upon its completion. The pretest may also serve to inform the design and content of the PD if participants' responses indicate a particular level of understanding from the onset. One should be careful that the pretest is not set up in such a way, though, that the participants' perceive it as a means of showing what they *do not* know. Guskey (2000) warns that PD designers, facilitators, and evaluators must maintain a respectful balance when considering the gathering of data and regard for their participants.

Level Three – Organization Support and Change

As mentioned in Guskey's (2000) Four Principles of Effective PD, it is not simply an individual change that PD is meant to support. Changing school culture is a difficult and complex matter that requires the collective development of values, beliefs, and norms with subsequent time, effort, and PD to support the process (Guskey). Organizational factors can make or break the success of PD in the school or district, and thus, must be evaluated thoughtfully.

Organizational support looks very different when applied to various types of PD activities, including conferences, workshops, study groups, or mentoring programs. In general, though, there are certain categories of questions that are applicable regardless of the format of the PD. The categories are

a. Organization policies
b. Resources
c. Protection for intrusions
d. Openness to experimentation and alleviation of fears
e. Collegial support
f. Principal's leadership and support
g. Higher-level administrators' leadership and support
h. Recognition of success
i. Provision of time (Guskey, 2000, p. 152)

Organization Policies. Questions regarding organization policy are important to include to make sure there are no policies in place that run counter to the objectives of the PD. Well –written questions can reveal both supportive and conflictive organization policies.

Resources. When considering the resources necessary to make the changes associated with PD, we must look beyond the obvious material resources and consider "information, facilities, technology, and access to appropriate expertise" (Guskey, 2000, p. 154).

Protection From Intrusions. Teachers also need to know that they are protected from intrusions as they explore their implementation of new knowledge. It is vital that organization leaders demonstrate their support for teachers during this time, and questions can show support or lack thereof.

Openness to Experimentation and Alleviation of Fears. Closely related to the teachers' need to be protected from intrusions is their need to feel open to experimentation without fear of reprisal. Trying something new carries the inherent risk of failure or embarrassment, so an organizational culture that values experimentation as a means to improve practices and grow as a professional is critical to relieving some of the anxiety that accompanies change.

Collegial Support. Collegial support goes hand-in-hand with administrative support. Opportunities for collaboration and sharing keep teachers from feeling isolated when implementing changes.

Principal's Leadership and Support. The building principal's leadership and support are also valuable to teachers who are trying to implement change. Often times the principal directly determines the amount of autonomy the teachers in the building have to experiment and make instructional changes. Teachers also tend to take cues from their principals with regard to their view of the value of PD and their commitment to improvement (Guskey, 2000).

Higher-level Administrators' Leadership and Support. Guskey (2000) is careful to remind us that organization support comes from more than just the building level. Support at the district level is also critical to motivating teacher change. Although some types of PD do not require the attention of district level administration, those that do can and should be evaluated.

Recognition of Success. For all the advocacy and encouragement that colleagues, principals, and district administrators may show along the way, formal recognition also has its place in supporting change. Recognition may come in many forms, including monetary, but the primary motivator for teachers is enhancing the learning outcomes for students (Guskey, 2000). Teachers are drawn to PD opportunities because they want to grow as professionals and be better teachers for their students.

Provision of Time. The final aspect of organization support and change is the provision of time for PD. This refers more to the time it takes to plan for and implement change than to attend PD events. Because of the critical nature of time as a factor in accomplishing change, Guskey (2000) provides suggestions for how schools or districts can find or add time for PD and its necessary follow-up activities. He suggests adding PD days to the school calendar or hours to the

school day, adding staff to clear up time for collaboration, using block scheduling with shared plan times, or using altered school or class schedules.

Guskey (2000) suggests that the most immediate evidence can be gathered through direct observation of activities, behaviors, interactions, etc. that answer so many of the possible questions for this data pool. Data gathered at level three of evaluation should be used to improve all aspects of organization support (Guskey, 2000). Even if levels one and two reveal that PD is being planned and executed properly, organization support is what can lead to success or failure of the change PD attempts to implement.

Level Four – Participants' Use of New Knowledge and Skills

Knowing if teachers like the PD experience, learned something new, and feel supported in their efforts all sets the stage for level four evaluation of the participants' actual use of their new knowledge and skills. This information cannot be gathered upon the completion of a PD session, but rather must be delayed until teachers have had a chance to practice and refine their new skills in the classroom (Guskey, 2000). After identifying appropriate indicators of use and their desired frequency and quality criteria, we must determine an adequate amount of time to have passed for relevant use to occur. Once the indicators, criteria, and timeline have been established, we may commence gathering data.

Data collection for this level of evaluation looks very different than any other. Efforts to gather data may include direct observations, participant interviews or conferencing, supervisor interviews or conferencing, student interviews or conferencing, focus groups, implementation logs and reflective journals, participant portfolios, or the use of comparison groups to measure

implementation. Although Guskey (2000) does not rule out the use of a questionnaire for evaluation at level four, he does note the possible tainting of evidence gathered solely through self-reporting from the participants. Data gathered on implementation that shows poor implementation practices can help explain the lack of associated student growth.

Level Five – Student Learning Outcomes

While the first four levels of PD evaluation focus on the participants and the organizations in which they work, level five asks questions about the effects of PD on student learning outcomes (Guskey, 2000). Perhaps because it is so difficult to link PD to student learning, there is a general lack of published studies that report on it. Gathering evidence of student learning as it relates to teacher participation in PD requires looking at cognitive, psychomotor, and affective outcomes similar to level two evaluation of participants' learning.

If the PD goals tied to student outcomes were present and needed to be measured, their assessment would be dependent upon the type of learning. Cognitive goals can be measured by any number of classroom assessments or activities. Psychomotor outcomes are the least commonly tied to PD goals, but could be assessed through observations, questionnaires, or accessing school records. Lastly, affective outcomes can be measured via questionnaires or interviews that take into account the Process of Affective Change. Knowing that affective change stems from cognitive change and can take significantly more time to manifest itself, the evaluator must give appropriate time for the change to occur before attempting to measure it.

Once the cognitive, psychomotor, or affective changes have been measured, the data should be used to focus and improve PD efforts. If student learning goals were absent or

improperly aligned with PD, the data will show that and should prevent future missteps in PD design, delivery, or evaluation.

Summary

It is unfortunate that so many of the efforts to evaluate PD often stop at level one or two of Guskey's (2000) Five Critical Levels of Professional Development Evaluation. While level one's focus on participants' reactions to the PD and level two's attention to participants' learning are extremely important, they provide an incomplete picture of the effects of the PD without including levels three, four, and five. Level three provides us with critical information on organization support and change. Level four takes a deeper look at participants' learning by assessing their actual use of the new knowledge and skills. And, finally, level five brings evaluation of PD back to what all PD is really intended to do – improve student learning.

There are many questions to ask at each level and appropriate methods of gathering and analyzing the data. Table 2 shows a brief summary of the five levels, highlighting the major questions addressed at each level.

While Guskey's (2000) framework allowed me to evaluate the Tech Teacher PD Program's outcomes, I relied on Activity Systems Analysis to investigate the intersystem interactions of three different activity systems over the course of time.

Table 2

Guskey's (2000) Five Critical Levels of Professional Development Evaluation (p. 79-81)

Evaluation Level	What Questions Are Addressed?	How Will Information be Gathered?	What Is Measured or Assessed?	How Will Information Be Used?
1. Participants' Reactions	• Did the participants like it? • Was their time well spent? • Did the material make sense? • Will it be useful? • Was the facilitator knowledgeable and helpful? • Did the physical conditions of the activity support learning?	• Questionnaires administered at the end of sessions • Focus groups • Interviews • Analysis of threaded discussion forums	• Initial satisfaction with experience	• To improve program delivery and design
2. Participants' Learning	• Did participants acquire the intended knowledge or skill?	• Paper and pencil instruments • Simulations and demonstrations • Participant reflections (oral and/or written) • Participant portfolios • Case study analysis • Analysis of threaded discussion forums	• New knowledge and/or skills of participants	• To improve program content, format, and organization

(Continued on following page)

Table 2. Continued.

3. Organization support and change	• What was the impact on the organization? • Did it affect organizational climate or procedures? • Was implementation advocated, facilitated, and supported? • Was the support public and overt? • Were problems addressed quickly and efficiently? • Were sufficient resources made available? • Were successes recognized and shared?	• District and school records • Minutes from meetings • Questionnaires • Focus groups • Structured interviews with participants and school or district administrators • Participant portfolios • Analysis of threaded discussion forums	• The organization's advocacy, support, accommodations, facilitation and recognition	• To document and improve organizational support • To improve future change efforts
4. Participants' use of new knowledge or skills	• Did participants effectively apply the new knowledge and skills?	• Questionnaires • Structured interviews with participants and their supervisors • Participant reflections (oral and/or written) • Participant portfolios • Direct observations • Video or audio tapes	• Degree and quality of implementation	• To document and improve the implementation of program content

(Continued on following page)

Table 2. Continued.

5. Student Learning Outcomes	• What was the impact on students? • Did it affect student performance or achievement? • Did it influence students' physical or emotional well- being? • Are students more confidents as learners? • Is student attendance improving? • Are dropouts decreasing?	• Student records • School records • Questionnaires • Structured interviews with students, parents, teachers, and/or administrators • Participant portfolios	• Student learning outcomes: - cognitive (performance and achievement) - affective (attitudes and dispositions) - psychomotor (skills and behavior)	• To focus and improve all aspects of program design, implementation, and follow-up • To demonstrate the overall impact of professional development

Activity Systems Analysis

Activity systems analysis is both a framework to guide investigations of human activity in a natural setting and a methodology for data analysis that can complement qualitative research. The activity systems model is used as a complementary component when organizing and discussing qualitative research data, allowing researchers to manage and communicate their findings in meaningful ways. The model's origin is in Activity Theory.

Activity Theory

Yamagata-Lynch (2010) provides a detailed history of a group of Russian and Ukrainian psychologists focused on the study of human activity. She notes that upon reexamination of Vygotsky's work on mediated action and Rubinshtein's activity theory (developed simultaneously but independently of Vygotsky's work), the Kharkovites – as this group was self-named – decided to focus on the psychological aspects of activity theory and use human activity as a unit of analysis. They took Vygotsky's idea of mediated action as a process and expanded it from the activity theory perspective to include "a series of processes that is contained within an activity that acts as a bounded system" (p. 20). Using human activity as a unit of analysis allowed them to consider both mental and observable activity, thus circumventing the criticism Vygotsky received for his views on internalization. Modern researchers have outlined the basic principles of activity theory based on the Kharkovites' extension of Vygotsky's work.

The Basic Principles of Activity Theory. Kaptelinin and Nardi (2009) use activity theory as a basis for examining and understanding how people interact with technology, including their ability to grow and change with technology. To apply activity theory to the investigation of human interactions with technology, they define the basic principles of activity theory: object-orientedness, the hierarchical structure of activity, internalization-externalization, mental processes vs. external behavior, interpsychology vs. intrapsychology, mediation, and development as an integrated system.

Activity Systems Analysis

To understand Engeström's (1987) activity systems analysis model, it is critical to first examine his four criteria for human activity. First, the activity must be in its simplest, original form. Second, its transformations or changes must be able to be analyzed within its own context, and third, they must be able to be analyzed with relation to the outside world. Lastly, the culture of the activity must be able to be analyzed. Engeström confirms that Vygotsky and Leontiev's activities as part of cultural historical activity theory meet these criteria.

Activity systems analysis is a methodology developed by Engeström to support a "systematic and systemic approach to understanding human activities and interactions in real-world complex environments" (Yamagata-Lynch, 2010, p. 1). Similar to activity theory, the activity systems analysis method uses object-oriented activity as its unit of measurement. Engeström (1987) stresses the importance of always considering the activity system as a whole rather than as separate connections. After Leontiev's addition of division of labor to the basic unit of analysis, Engeström expanded Vygotsky's mediated action triangle (see Figure 5) to

incorporate the entire activity system, including the original *subject, tool,* and *object* as well as *rules, community, division of labor,* and *outcome* (Engeström, 2009).

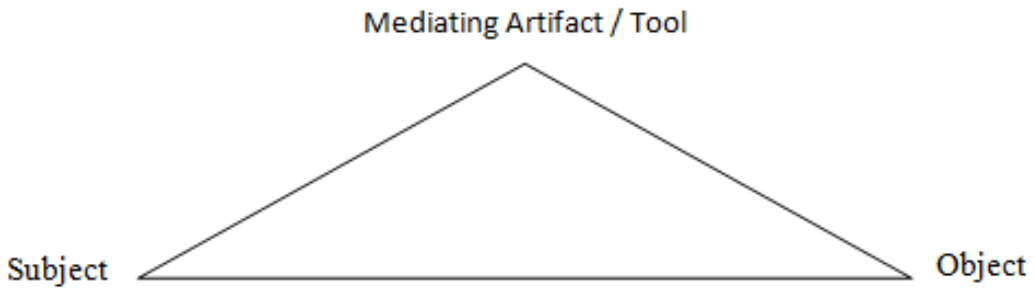

Figure 5. Vygotsky's Mediated Action Triangle (Yamagata-Lynch, 2010, p. 17)

Yamagata-Lynch (2010) identifies the parallels between Engeström's activity system and Vygotsky's mediated action model. Similar to Vygotsky's model, the *subject* is the individual or group of individuals involved in the activity. The *tool* in Engeström's system corresponds to Vygotsky's mediating artifact or tool and includes social others and artifacts that can act as resources for the subject in the activity. Also mirroring Vygotsky's model, the *object* in Engeström's system is the goal or motive of the activity.

Yamagata-Lynch (2010) continues with the elements Engeström's activity system adds to Vygotsky's model, including the *rules, community,* and *division of labor.* The *rules* directly relate to the subject of the activity and represent regulations that can affect how the activity takes place. The *community* is the social group that the subject belongs to while engaged in activity and is related closely to the subject, the rules, and the division of labor. The *division of labor* refers to how the tasks are shared among the community that is involved in the activity. Finally,

the *outcome* of an activity system is the end result of the activity, which may be different from the object itself (Yamagata-Lynch). (see Figure 6)

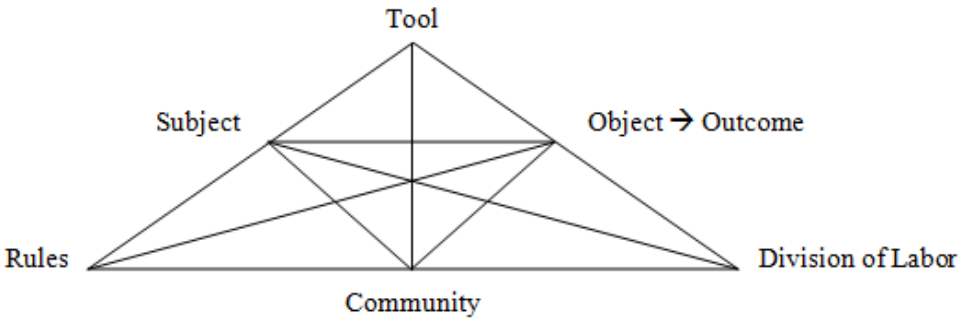

Figure 6. Engeström's Activity System (Yamagata-Lynch, 2010, p. 2)

The activity systems model is not static (Engeström, 1987), and thus the actions and interactions within the system can lead to tensions or contradictions. These tensions may have an effect on the object, the outcome, or the subject's satisfaction with the activity. The tensions may also have greater implications outside of the singular activity system where they originate.

Tensions

In addition to building on Vygotsky's mediated action triangle to develop the activity systems analysis method, Engeström introduced the idea of systemic contradictions, or tensions, that contribute to the resulting outcome of the activity. Yamagata-Lynch (2010) explains that the tensions may originate from outside the activity or from within the activity system and may change the way a subject participates in the activity or is kept from attaining the object at all.

These tensions can influence the interactions among the elements of the system and, ultimately, affect the outcome of the activity. The subject may not attain the object or may not be satisfied with the outcome. In some instances, rather than working as a complication to the subject attaining the object, the tensions may work to facilitate the process.

The purpose of identifying the systemic contradictions is to show how external or internal changes in the activity system of human action can be a factor in the overall outcome. Rather than providing a causal relationship, the tensions simply reveal the complexity of human activities (Yamagata-Lynch). Engeström (1987) describes four levels of inner contradictions to help researchers identify tensions and modify activities by overcoming the tensions. (see Table 3)

Table 3

Engeström's Four Levels of Inner Contradictions in Activity Systems (adapted from Yamagata-Lynch, 2006, p. 9)

Contradiction Level	Engeström's Definition
Level 1 Primary Contradiction	Participants encounter more than one value system attached to an element within the activity.
Level 2 Secondary Contradiction	Participants find that assimilating a new element into the activity brings about conflict.
Level 3 Tertiary Contradiction	Participants feel conflicted when adopting a new method for achieving the object.
Level 4 Quaternary Contradiction	Participants encounter changes in the activity that conflict with other activities.

Systemic Implications. Because of the complicated nature of Engeström's activity system, tensions are just one of the interactions to be considered. Another type of interaction is found in the systemic implications that this model generates (Yamagata-Lynch, 2010). The actions within one activity system can have a direct impact on the actions of another related system. This allows investigators to adjust their research to incorporate a series of related activities rather than one single instance. This concept of interrelated activity systems gives qualitative researchers a method for organizing data that otherwise may not have revealed the relationships among activities (Yamagata-Lynch).

Conclusion

This review of literature about technology usage in education, including barriers to technology integration, and a review of technology related PD practices provides a strong foundation for this research endeavor. The barriers to technology integration provide insight into the reasons technology integration has not permeated the educational world as it has in other professions. Whether the authors divided the barriers into two, four, or six categories, they had common ideas about what keeps teachers from integrating technology in their curriculum. Some barriers are out of the teachers' or the district's control, while others can be addressed through quality PD.

Unfortunately, the PD for technology integration in its current state was not found to be adequate. The technocentric content, the time allotted for training, the lack of meaningful context or objectives, and the impersonal format of current PD cause it to be ineffective in achieving technology integration. Technology related PD is not only a cause for some of the current

barriers, but can also supply a means to overcome the barriers if designed according to Guskey's (2000) Four Key Principles of Professional Development.

This review of the literature has clearly revealed the main issues surrounding technology integration and the potential for job-embedded technology PD as a means to remedy the situation. When teachers learn *how* to use technology through a system of peer collaboration rather than just *what* technology to use, they will be better equipped to engage in effective technology practices for their students. The frameworks for evaluating the TTPD Program and examining the intersystem interactions were the foundation for collecting and analyzing data, as will be discussed in detail in Chapter 3 concerning the research methodology used in this study.

CHAPTER 3: METHODS

Introduction

This case study examined a TTPD Program in terms of participants' knowledge and beliefs, perceptions of organization support, and perceptions of skills in working collaboratively with classroom teachers. Additionally, this study will examine the intersystem interactions of three activity systems that exist either concurrently or consecutively over the course of the study. The final result of both of these strands of research provided valuable information to inform future decisions about technology integration and appropriate staffing in the Newton District 57.

This chapter addresses the purposes of the study and the research questions. It then provides a detailed description of the research design. Details about the TTPD Program, the setting, and the participant selection are followed by data collection, data analysis, verification procedures, limitations, and finally, a summary.

Purpose Statement

The primary purpose of my research was to assess the effects of the TTPD Program on the knowledge, beliefs, and feelings of preparedness of a group of Tech Teachers. The three components were assessed before and after their participation in a specialized PD program during the Spring and early Summer of 2015. A secondary purpose of my research was to

investigate the relationship among the current activity system involving the Tech Teachers as subjects and the activity systems that would exist during and following their participation in the TTPD program. A final consideration was the Tech Teachers' perceptions of organizational support within the school and district that would be needed to make the TIS Program a success. All of the data gathered and analyzed as part of this study informed future PD for the Tech Teachers, district administrators, and even classroom teachers as the district prepares to implement the TIS Program.

Research Questions

My research sought to answer the following questions. The first three questions addressed the evaluation of the TTPD Program. The last question examined the intersystem interactions throughout the process of changing from Tech Teachers to TIS.

1. Did the Spring 2015 TTPD Program change the Tech Teachers' knowledge and beliefs about technology integration?
2. What are the Tech Teachers' perceptions of organizational change and support as the district progresses toward the implementation of a TIS Program?
3. Did the Tech Teachers feel that the PD Program provided them with the necessary skills to participate successfully in the TIS Activity System?
4. What are the complementary and contradictory intersystem interactions that manifest during the progression of the Tech Teacher through the three activity systems? (current, during PD program, and TIS implementation system)

The Tech Teacher Professional Development Program

I worked in collaboration with the Instructional Technology Coordinator to present to our Assistant Superintendent of Educational Services a description of the qualifications and responsibilities of an ideal TIS. Because we knew that revamping the current job description of our Tech Teachers was not an option at that moment, our proposal also included an interim PD program to help move the Tech Teachers in this new direction by building their knowledge and skills to align with what we valued in a TIS. The TTPD Program was structured as a combination of before-school meetings with the participants supplemented by six half-day pullout sessions. This PD occurred during the spring and early summer of 2015, specifically from January 2015 to June 2015.

Setting

The research took place at various elementary and middle schools within the district as predetermined by the Tech Teachers' PLC schedule. The district serves low-performing students in an impoverished Midwestern suburb with a 63% 4-year graduation rate and a 20% college readiness score (School Report Card, 2014). The students from the community are primarily Hispanic with 75% low income families and 34% English Language Learners (School Report Card, 2014). There are 823 teachers in the district with 53% holding a Master's degree or beyond (District Profile, 2013).

This district has abundant technology available, including a desktop computer, interactive whiteboard, and document camera in each classroom. Various carts in each building also give

teachers access to laptops or iPads for student use with WiFi access points throughout all buildings. Almost every K-8 building has a full-time Tech Teacher who *can* give assistance with technology to classroom teachers although it is not an official capacity of their job, as their primary responsibilities are to work with students and maintain the lab and computer carts.

Participants

Although case study research does not use data from large samples to come to generalizations about a population according to Stake (1995), researchers should still take care in selecting cases for multiple-case designs in hope of defending any generalizations that arise from a cross-case synthesis. The participants for my study were the result of purposeful sampling as defined by Bogdan and Biklen (2007) due to the access I had to the particular population and my belief that they would further the understanding of my case. All participants were Tech Teachers in Newton District 57 who participated in the TTPD Program as part of their PLC time and scheduled pull-out days. All but one of the participants were females ranging in age from 22-55 with varying years of experience in education and comfort levels in technology use. I purposefully limited qualitative data for my case study to a maximum of six, as suggested by Creswell (2007), choosing what appear to be typical cases. Yin (2014) agrees that for a case study seeking to develop deeper understanding rather than create generalizations, a convenience sample of six participants is acceptable. Three of the Tech Teachers agreed to participate in the case study portion of the research. The mixed methods approach of this study with an emphasis on the qualitative to provide an in-depth understanding of the phenomena only used the

quantitative data to validate the "analytical generalizations" (Yin, 2014, p. 40) rather than to suggest statistical generalizations about the population.

Elementary and middle school Tech Teachers in the district must hold a Professional Educator License (PEL) in elementary or middle school education with one of a variety of endorsements. Middle school Tech Teachers also have the additional requirements of carrying a grade-level endorsement and having passed the state tech teacher exam (see Table 4). A Library Information Specialist endorsement was the most prevalent qualification among the Tech Teachers who participated in the TTPD Program. One Tech Teacher had a Bachelor's degree in Business Technology and others had or were pursuing Master's degrees in Educational Technology, Library Science, or Education (personal communication, December 26, 2014). The qualifications of the specific teachers whose data was used in the study will appear in Chapter 4 of this dissertation.

Table 4

Tech Teacher Job Description Qualifications

Qualifications per job description	Professional Educator's License	Endorsements	Library Information Specialist	Technology Specialist	Computer Applications	Computer Science	Business	Marketing and Management	Marketing and Computer Education	Appropriate grade level endorsement	Passed the Tech Teacher Exam
Elementary Tech Teachers	X		X	X	X	X					
Middle School Tech Teachers	X		X	X	X	X	X	X	X	*	*
* - Additional requirements for Middle School Tech Teachers											

Participation in the study was solicited in the spring semester of 2015 in a discussion at the initial PLC meeting. Teachers were provided with a description of the TTPD Program in December of 2014. At the January PLC meeting, they received a detailed list of the requirements of their participation. Teachers who agreed to participate in the study were asked to sign a consent form approved by the IRB of Northern Illinois University agreeing to participate and possibly be digitally audio and video recorded. Use of data from surveys administered online also required the district's consent. To ensure confidentiality, the district, the school, and each teacher were assigned pseudonyms only known to the researcher. Any other identifying characteristics were omitted from the final report or provided alternate names as well. Additionally, all documentation for the study was kept in a locked cabinet or password protected file.

The Curriculum and Timeframe

The content of the TTPD centered around seven main topics: (1) the ISTE Standards for Teachers; (2) the ISTE Standards for Students; (3) the ISTE Implementation WIKI; (4) Harris and Hofer's Learning Activity Types; (5) the SAMR Model of technology integration; (6) Adult Learning Theory; and (7) Instructional Design for technology PD. It was our opinion that, if the Tech Teachers participated in the TTPD, they would be better equipped to take on the TIS role when the district administration decided to implement it.

The program began in January of 2015 and extended through June of 2015. We met during half of the Tech Teachers' weekly PLC meetings and used six half-day pullouts to cover the topics and provide opportunities to observe and practice application of their new knowledge.

A pre-test was administered prior to the program to assess current knowledge of the PD topics and beliefs related to technology integration practices. The results of this pretest were used to tailor the TTPD Program to meet the needs of the participants.

The Purpose of the Program

Guskey (2000) tells us two of the many reasons that PD is important center on its relation to individual teachers and to the educational system as a whole. First, it allows teachers to keep up their expertise level in both content and pedagogical practices. And, second, in the context of educational reform, PD provides a means to learn about and act upon shifting roles within the organization. When considering the Tech Teacher PD Program, the curriculum was chosen to assist the Tech Teachers to build their personal knowledge about technology integration standards, to extend their repertoire of teaching practices to working with adults, and to be as prepared as possible to take on a change in their role in the organization once the TIS program was implemented. The evaluation of the TTPD Program informed the district administration of our readiness to shift the Tech Teachers into TIS roles, including any additional PD that would be needed to simplify the transition.

The Characteristics of the Program

The TIS Program embodied the defining characteristics of PD. It is *intentional, ongoing,* and *systemic* in nature (Guskey, 2000). Having a clear purpose with goals that were worthwhile and able to be directly addressed illustrated the intentionality of the program. The goal of filling the TIS positions using our current Tech Teachers was worthwhile because we already knew

their skillset with using technology, so it would be more manageable than working with new employees. The same goal was able to be addressed because a needs assessment was conducted to tailor the PD program, and we already had scheduled meeting times at which the Tech Teachers were expected to be in attendance.

The TTPD Program was also ongoing in that we provided this PD over the course of five months. Additionally, we encouraged building administrators to allow the Tech Teachers to start implementing what they were learning in the PD right away. This low-stakes ability to practice and hone their skills before a formal switch to the TIS program was just what some Tech Teachers needed to build their confidence, and what others needed to come to the realization that the TIS role was not the right role for them. This point connects directly with the systemic nature of the PD program. It considered the individual growth of the Tech Teachers as well as the growth of the organization on both a building and district level. At the building level, Tech Teachers were able to spend more of their time working with classroom teachers rather than providing interventions to students that were completely unrelated to technology integration. At the district level, this PD program, and the results of it informed decisions made about staffing for the buildings not represented in this study if there was an indication of need for similar positions at the Early Childhood Center, the Magnet Academy, and the High School.

The TTPD Program was the focus of the PD evaluation that my study proposed. Additionally, the three activity systems that I will study are the current reality of the Tech Teachers role, the anticipated system during their participation in the TTPD Program, and the system that would exist when the TIS program was implemented.

Research Design

To address both purposes of the study, I chose a pragmatic parallel mixed methods design for my research to provide a deeper understanding and a more complete picture (Mertens, 2010) of evaluating the TTPD Program and the intersystem interactions of the three activity systems. Participants were surveyed at the beginning and end of the research period in the form of a pre- and post-survey that gathered both quantitative and qualitative data about the participants' self-assessment of their knowledge of the TTPD Program's proposed curriculum, their perceptions of organization support, and their perceived ability to fulfill the duties of the TIS role. Qualitative data were gathered throughout the duration of the program in the form of meeting notes, discussion boards, and observations. The total accumulated data pool was examined at the conclusion of the TTPD Program to complete the analysis of the intersystem interactions. While both data types were collected and compared, the emphasis of data collection and analysis was qualitative in nature because of the desire for greater understanding of the phenomena being studied and the limited sample size represented.

As a methodology, case study allows the researcher to examine complex social phenomenon in a real-world context to provide an in-depth account of how or why that phenomenon works (Yin, 2014). Case study is more frequently used to answer "how" or "why" questions that describe or explain, respectively, the phenomenon in its context. Yin's definition states that a case study manages the existence of fewer data points than variables of interest and, as such, relies on the convergence of multiple data sources while taking advantage of previously developed theoretical propositions to guide data collection and analysis. Yin contends that this "all-encompassing method" (p. 17) allows for both single- and multiple-case studies, the

inclusion of quantitative data (Creswell, 2007), and research for the purpose of evaluation (Stufflebeam & Shinkfield, 2007). As an evaluation of a PD program that seeks to provide stakeholders with an "authoritative, in-depth, well-documented explication of the program," (Stufflebeam & Shinkfield, 2007, p. 182) a case study involving various data sources was entirely appropriate for the TTPD examination.

A collective case study was used to gather the data from program participants in a variety of forms to corroborate the quantitative data and provide a more profound understanding of the complementary and contradictory intersystem interactions. Multiple-case designs can provide evidence that will be considered more compelling and robust as compared to single cases due to their ability to yield either literal or theoretical replications (Yin, 2014). Yin also contends that multiple-case design is common in the study of school innovations, particularly new educational technology.

Data Collection

Data were collected using a variety of strategies and instruments to ensure a rich description and to facilitate cross-case synthesis. A combination of surveys, online discussion boards, classroom observations, document review, and meeting notes were used to answer the proposed research questions for the examination of the TTPD Program as well as the analysis of intersystem interactions.

Surveys

Surveys are a common data collection tool and are often cited in research. Although generally used with a larger sample size, a longitudinal survey is appropriate to study a group of individuals over time (Mertens, 2010). Surveys for this study included mixed question types. The data from the Likert scale survey items were used to supplement various forms of qualitative data in this mixed methods research design. Open-ended questions were used to gather greater detail when teachers rated themselves as having advanced knowledge and application of the TTPD Program's curriculum content and also added to the qualitative data.

Pre-test Survey Design and Purposes

Guskey (2000) explains that surveys are a customary form of professional development evaluation that often include Likert type questions as well as open-ended questions. I designed a survey instrument (see Appendix A) that was used as a pretest to serve three basic purposes. First, it allowed the tech teachers to self-report their present knowledge of the planned curriculum for the TTPD Program. Statements rated at 3, 4, or 5 also required a brief open-ended response to provide further detail on the Tech Teacher's knowledge and related practices. The second section of questions assessed their perceptions of organization support in the current activity system. The questions in this section were based on Guskey's Levels of Professional Development Evaluation and provided data to be incorporated into the implementation planning for the proposed TIS Program. The third and final section asked the participants to assess their own abilities to fulfill the duties associated with the TIS role. The majority of the Tech Teachers

did not act in a TIS-like capacity in their buildings at the time of the study. The purpose of these questions as a pretest was to inform the content and design of the TTPD Program. The same survey was administered at the end of the TTPD Program for different reasons.

Validity of the Survey Tool. Because I created the survey tool in collaboration with the Instructional Technology Coordinator, I asked a group of Tech Teachers in the local community to validate the content of the instrument. Tech Teachers in the county meet once a month with the Regional Office of Education, and I petitioned them at the January 2015 meeting to examine the survey and provide feedback on the clarity of the questions, wording choices, and length of time to complete the survey. Suggestions to change question phrasing in one item and to lengthen the time estimate for the survey were incorporated in the final draft of the survey instrument and survey description, respectively.

Posttest Survey Design and Purposes

Using the exact same survey instrument for the pre- and posttest allowed me to analyze any gains in knowledge or changed perceptions of organization support or personal abilities. Responses to the questions in the first section revealed whether or not the TTPD Program accomplished its learning objectives. As with the pre-test, statements of knowledge rated at 3, 4, or 5 required a brief open-ended response to provide further detail on the Tech Teacher's knowledge and related practices. The second section of questions assessed their perceptions of organization support upon completion of the TTPD Program. Any changes in the Tech Teachers' perceptions of organization support gathered from the posttest survey were used for the same purpose of informing implementation planning for the proposed TIS Program. The third and final

section asked the participants to re-assess their own abilities to fulfill the duties associated with the TIS role after participating in the TTPD Program. After having the opportunity to collaborate with a classroom teacher in at least one experience as required by the TTPD Program, the Tech Teachers' self-assessment of their ability to function as a TIS may have changed. The results from these posttest questions provided data about what further training, if any, would need to be designed and executed to meet the needs of the Tech Teachers as the district prepared for the transition to a TIS program. This information may have also informed the timing of the TIS program implementation. If insufficient gains were made with the current staff of Tech Teachers, the district may have considered postponing the program or making changes to the program design. The quantitative and qualitative data from these surveys was complemented by other qualitative sources.

Online Discussion Boards

A second method of data collection involved online discussion boards with the participants. In an effort to make the study as flexible as possible for the participants, I asked the Tech Teachers to respond to a discussion board prompt after each meeting to collect confidential feedback about the session and any reactions they wanted to share regarding the utility of the content in relation to the potential TIS responsibilities. Questions were written on-demand after each meeting to be reflective of the content and atmosphere of that particular gathering. Each question was framed in such a way that allowed the Tech Teachers to provide a personalized response and also react to the responses of other participants.

Online discussion boards are not a common method of data collection for program evaluation, and therefore do not appear in the traditional texts on research design. Some possible advantages to hosting online discussion boards are: 1) the confidential nature of submitting responses under an alias or avatar may lead to more candor; 2) the ability to submit responses at a convenient time and from a convenient location gives the participants flexibility and shows consideration for their busy schedules; 3) the instant transcription of data helps to avoid any misinterpretations of audio recordings; and 4) the ability to share files through the same discussion board allows for collection of documents relevant to the question prompts. The confidential discussion board submissions were complemented by at least one classroom observation for each Tech Teacher who agreed to participate in the case study portion of the research.

Classroom Observations

Because case studies investigate current phenomena, direct observations are another source of evidence I used in this study. Yin (2014) points out that observations of technology in the real-world setting of the case are particularly valuable in understanding its use and problems that may be encountered. One observation of each participating Tech Teacher providing one-on-one support to a classroom teacher or delivering a technology related PD session was conducted to collect data about the participants' application of the knowledge and skills taught in the TTPD Program. Classroom observations were approximately 30-45 minutes in length, while observations of PD delivery did not occur by choice of the case study participants. These observations were informal and used to provide feedback to the Tech Teachers.

Documentation

Because documents cannot be accepted as literal recordings of events that have taken place, the most important use of documents is to corroborate and augment evidence from other sources (Yin, 2014). I collected documents from the participants confidentially through uploads to the online discussion board during the course of the TTPD Program. I anticipated that each participant would submit at least one document over the course of the program. To complement the discussion board contributions and classroom observations, documents such as collaboration / reflection logs created by Tech Teachers working with individual classroom teachers, instructions created for students or teachers for use during a curriculum-based technology lesson, multimedia presentations or handouts used in an after-school tech training, and other relevant artifacts were also collected as evidence of participant knowledge, skills, and beliefs about technology integration practices. These materials also provided data for the intersystem interactions analysis. Keeping the central research questions in mind helped focus the collection of documents and guide their interpretation.

Meeting Notes

Finally, notes taken by the researcher during TTPD meetings and in reflection sessions with the Instructional Technology Coordinator after the meetings addressed both purposes of the study by collecting data regarding the TTPD Program and the participants' involvement in the activity systems. I created a template for note taking to promote consistency in the focus of my notes and their potential to answer the research questions of the study (see Appendix B). The PD

meeting sessions focused on learning about the standards, theories, and practices of the proposed PD curriculum, and they also provided a forum for discussion of Tech Teachers' experimentation with one-on-one interactions with classroom teachers implementing technology in the curriculum. The researcher took notes during the sessions. These sessions provided a wealth of data for the study and were a major contributor to the case study database of evidence.

The use of surveys, online discussion boards, classroom observations, document review, and meeting notes provided more than sufficient evidence to answer the research questions for this study. Using these methods to examine TTPD Program and the intersystem interactions of three activity systems offered the deeper understanding sought by the research questions. Table 5 summarizes the data collection methods and their corresponding research questions.

Data Analysis

Researchers who employ a mixed methods design have to be knowledgeable in quantitative and qualitative data analysis (Mertens, 2010). This section details the data analysis methods used to examine quantitative and qualitative data in corresponding sub-sections and includes descriptions of the specific methodologies and instruments used for different data sources in this study.

Quantitative Data

The quantitative data gathered in this study were not intended to produce generalizations about a population, but rather to complement the qualitative data and provide a more clear

understanding of the effects of TTPD Program. The use of descriptive statistics in this study was to organize, summarize, and simplify the quantitative data (Gravetter & Wallnau, 2011).

Table 5

Summary of Research Questions and Corresponding Data Collection Methods

	Survey – Likert scale	Survey – open-ended	Online Discussion Board	Classroom Observations	Documentation	Meeting notes
Research Question #1: Did the Spring 2015 TTPD Program change the Tech Teachers' knowledge and beliefs about technology integration?	X	X	X			X
Research Question #2: What are the Tech Teachers' perceptions of organizational change and support as the district progresses toward the implementation of a TIS Program?	X		X	X	X	X
Research Question #3: Do the Tech Teachers feel that the TTPD Program provided them with the necessary skills to participate successfully in the TIS Activity System?	X		X			X
Research Question #4: What are the complementary and contradictory intersystem interactions that manifest during the progression of the Tech Teacher through the three activity systems? (current, during PD program, and TIS implementation system)	X	X	X	X	X	X

Frequency Distribution

Frequency distribution was used to analyze the data from the Likert-scale questions on the pre- and post-survey instrument. This method of organizing the data according to the number of responses in each category on the scale of measurement allowed the researcher to see the entire set of scores "at a glance" (Gravetter & Wallnau, 2011, p. 36). Organizing the data in this way was useful to the researcher who normally works with qualitative data because the resulting organization of the quantitative data according to a frequency distribution can be likened to the process of visually coding data with rich text formatting tools to give a visual representation of the data. The frequency distribution calculated in this part of the quantitative data analysis was further examined for a calculation of the mean.

Central Tendency

By adding the frequency of the scores and dividing by the number of participants who completed the survey, I calculated the mean, or average score that represented the group of Tech Teachers as a whole with a single score. The median also proved to be a useful calculation with the data gathered from the survey instrument, in the case of extreme scores that inflated the mean. With such a small *n* size, an extreme score has the potential to contribute to a mean calculation that is not representative of the majority of responses (Gravetter & Wallnau, 2011). The mean and median calculated from the quantitative data was useful in the interpretation of the qualitative data gathered in the study.

Qualitative Data

The bulk of data collected during this research was qualitative. It is important to note that not all coding methods are appropriate to all data types (Miles, Huberman, & Saldaña, 2014; Saldaña, 2013). Due to the amount of data collected, the data was carefully prepared for coding and various coding methods were used to make the connection between the data and its meaning, including pre-coding, descriptive coding, In Vivo coding, and emotion coding. A code is a "researcher-generated construct that symbolizes and thus attributes interpreted meaning to each individual datum for later purposes of pattern detection, categorization, theory building, and other analytic processes" (Saldaña, p. 4). Saldaña suggests that beginners code as much data as possible to gain experience and to avoid omitting important evidence from the study.

Each of the data types for each of the study participants was coded separately and then compared in a cross-case synthesis to make "analytic generalizations" (Yin, 2014, p. 40). I performed First Cycle and Second Cycle coding at a minimum and kept analytic memos that were also coded. The coding process overall led from codes to categories to themes in the data.

Pre-coding

It is important to begin analyzing the data as soon after its collection as possible and to avoid a time lapse that would require the researcher to rely on memory (Saldaña, 2013). I used pre-coding methods including preliminary jottings and rich text features to analyze the data from the very beginning. Saldaña notes that although preliminary jottings are not finalized codes, the ideas they represent may lead to further analytic considerations. Using rich text features of a

word processing program such as Microsoft Word provided a visual representation of the data that also led to recognizing codes and categories in the data. In this stage of the analysis, I gravitated toward use of highlighting in different colors the terms and phrases I found to be related. Additionally, I used the bold text feature to make note for myself of possible larger categories to which I might assign the terms and phrases as I gathered more notes.

Descriptive Coding

Descriptive coding summarizes the basic topic of a selection of qualitative data in a short word or phrase (Saldaña, 2013). This method of coding is particularly appropriate to beginning coders and to studies with a variety of data sources. Preparing the data by breaking it into sections where the topic seems to change will facilitate the process of identifying the topics with fitting descriptive codes. Descriptive codes can lead to the creation of categories and are an essential part of Frist Cycle coding. The bolded words that I generated in my pre-coding often led to the topics I used upon further review of my notes for descriptive coding. I was able to identify data from different sources (i.e. meeting notes, discussion board submissions) that fit into larger categories. The pre-coding colors used across my data sources was extremely useful when I reached the descriptive coding stage. I was able to consolidate various pieces under bigger topics with this second pass through the data.

In Vivo Coding

In Vivo coding uses the actual language of the participants and is a good way for beginning coders to honor the participants' voices (Saldaña, 2013). This helped to capture the

terminology specific to the interactions between Tech Teachers and classroom teachers. Certain terms like "configuration" and "web-based applications" may appear in this coding because they are phrases that Tech Teachers use in their daily practices. Use of In Vivo coding also helped the researcher notice themes related to the participants' beliefs about technology integration. Saldaña notes the possible consequences of over reliance on In Vivo coding, however, because it may limit the researcher's ability to move on to more theoretical and conceptual levels of analysis. In Vivo coding was particularly useful in singling out terms specific to the Tech Teachers' voices. It was at this point that their use of TIS as a description of their desired responsibilities came through, unsolicited by me or my co-presenter.

Cross-case Synthesis

Cross-case synthesis can be used for multiple cases that are part of the same study by treating each case as a separate study and then aggregating the findings into a single representation (Yin, 2014). Yin suggest that, for the modest number of cases involved in this study, the cross-case synthesis can be used to explore the replicated or contrasted results to confirm or disconfirm the original research expectation and make connections to the existing literature. By considering the different categories and themes that arise from the analysis of the variety of qualitative data sources for each participant and comparing them to the other participants' the research can be considered more robust and the researcher's interpretations of the qualitative data are validated. I used cross-case synthesis in comparing and contrasting the discussion board comments and classroom observations of the three case study participants. I also went back through my meeting notes and any documentation created during the TTPD by

these three case study participants to combine it with the discussion board comments and my observation notes. Examining each individual's combined data set was then complemented by a similar descriptive coding cycle including all three sets of data.

Activity Systems Analysis

Activity systems analysis can be used in qualitative research to help make datasets gathered from complex real-world activities more manageable and meaningful than they might be with traditional themed analysis (Yamagata-Lynch, 2006, 2010). Among the advantages of using activity systems analysis methods for qualitative research is its ability to provide a manageable unit of analysis, to uncover systemic implications, to recognize systemic contradictions and tensions, and to communicate findings. Activity systems analysis will be used to answer research question #4: What are the complementary and contradictory intersystem interactions that manifest during the progression of the Tech Teacher through the three activity systems (current, during PD program, and TIS implementation system)?

The amount of qualitative data to be collected for this study could have been daunting to a beginning coder, but careful preparation and the use of various coding methods helped keep the analysis focused on generating "analytical generalizations" and providing the deeper understanding of the phenomena addressed in the research questions. Pre-coding, descriptive coding, and In Vivo coding used in First and Second Cycle coding all contributed to a more meaningful cross-case synthesis. Table 6 provides a summary of the coding methods used in this study and their corresponding data sources.

Verification Procedures

Three measures were used to verify the researcher's data analysis, including peer reviewers, member checking, and triangulation of data through multiple data sources. The researcher used two peer reviewers to verify her data analysis results. One reviewer was the Director of Curriculum with her Ed.D. in Curriculum and Instruction. The other peer reviewer was the Instructional Technology Coordinator who is a K-9 certified teacher with a Master's in

Table 6

Summary of Coding Methods and Corresponding Data Sources

	Survey – Likert scale	Survey – open-ended	Online Discussion Board Contributions	Classroom Observations	Documentation	Meeting notes
Pre-coding	n/a	X	X	X	X	X
Descriptive coding	n/a	X	X			
In Vivo coding	n/a	X	X			
Cross-case synthesis	n/a	n/a	X	X	X	X

At various points during the data collection, and following the peer review, the researcher provided each participant with the results from her respective data analysis for member checking to increase the validity of the study (Mertens, 2010). Participants were asked to review the data to suggest additions, deletions, or re-wording of passages to more accurately portray their intended meanings. This was done through a process in which I emailed drafts to the Tech

Teachers and asked them to make changes electronically and then upload the document to the online discussion board. This way, the revisions remained confidential and I was able to avoid misinterpretations of handwritten submissions.

The cross-case synthesis and comparison of quantitative and qualitative data was the third measure taken to increase the validity of the study. The use of multiple methods and multiple data sources, or triangulation, strengthens the researcher's interpretations and conclusions in qualitative studies (Mertens, 2010).

Limitations

To address the construct validity of my study, I acknowledge its various limitations, including my involvement as the professional development designer/provider and my status as an administrator in the district. I recognize the nature of my "Lone Ranger research" (Bogdan & Biklen, 2007, p. 80) and the limitations I had as a single researcher performing the entire mixed method research alone.

Bracketing the Researcher's Experience

Because I, the researcher, was the collector of data, it was critical that I maintain a balance among my etic and emic perspectives and my personal background, always considering how they may have affected the study (Yamagata-Lynch, 2010). I had to maintain a clear focus and make sure that the research questions were what guided my data collection at every step.

This study was designed to examine the TTPD Program that I conceived, cooperatively proposed and designed, and co-delivered in order to support the implementation of a TIS

program in Newton District 57. Although the success of the TTPD Program was not a determining factor in my employee evaluation or continued service to the district, it was certainly a matter of personal pride when considering the outcomes of the program. My work with the Tech Teachers may have been viewed as controversial due to my status as an administrator in the district, however, I was not responsible for the employee evaluation of any of the Tech Teachers. The confidential nature of the surveys and online discussion board submissions also freed me from revealing any information to building principals who may have inquired about their Tech Teacher's success in the program. Maintaining a level of professionalism that allowed me to be completely objective about the results of the program evaluation was difficult, but I recognized the necessity of said objectivity to make accurate analytical generalizations that would contribute to the district's planning and to the field of PD in general. My own objectivity was not the only consideration for reporting on the data gathered in my study.

Considerations for Self-Reported Data

I also concede that self-reporting may have been biased in the case of the pre- and posttest surveys about the participants' knowledge, beliefs, and skills. The requirement of a detailed response for self-ratings of 3, 4, or 5 on the Likert scale was one way that I attempted to assess the justification of the rating with details that aligned to the intended outcomes of the TTPD Program. Another opportunity for biased responses was in the online submission of answers to discussion board prompts. By allowing the participants to select pseudonyms and/or avatars to tie to their answers, some teachers may have taken advantage of the confidential nature

of the communications and included irrelevant information. My intention was to allow the participants to submit genuine answers without fear of repercussion, but I also recognize the depersonalization the online discussion board may have detracted from my ability to gather as much insight as possible.

Internal and External Validity

When considering internal and external validity, I was very detailed in my descriptions of the data collection and analysis and the implications for the study. By using the Microsoft Excel program for analysis of the quantitative data, I hoped to significantly decrease the possibility of miscalculating the pre- and post-survey results. As mentioned previously, peer reviewers, member checking, and data triangulation were used to strengthen the validity of the study. I anticipated being able to report findings about this design of PD that would contribute to the field of PD in general.

Reliability

Finally, I addressed the reliability of my study by maintaining precise documentation of every possible step of my research. As suggested by Yin (2014), I developed a detailed protocol so my study could be replicated. Keeping all documentation in a password-protected online account that gave a time and date stamp to every note and document provided an audit trail for the research that could be traced from the beginning to the end of data collection and analysis. It was my hope that the results of this study would provide the district with enough information to

make an educated decision about the future implementation of the TIS program, so it was to everyone's advantage that I kept excellent records.

Summary

This study employed a mixed method research design to address the dual purposes of the research. This chapter provided a brief description of the TTPD Program to give a more thorough understanding of the participants' experience. The setting and participant selection were described in detail to give a clear picture of the teachers and the environment used for this study. The data collection section defined each of the methods for collecting both the quantitative and qualitative data sources. The data analysis section was divided into methods used for quantitative and qualitative analysis and was followed by a brief account of the verification procedures that were used throughout the data collection and analysis portions of the study. The limitations of the study were acknowledged in the last section of this chapter to inform the reader of the researcher's awareness of possible weaknesses of the study.

CHAPTER 4: DATA ANALYSIS

Introduction

This chapter provides an analysis of quantitative and qualitative data collected before, during, and after the TTPD Program that occurred in Newton District 57 between January and June of 2015. Quantitative data included pre- and post-survey responses. Qualitative data were collected from open-ended pre- and post-survey responses, meeting discussions and documents, online discussion boards, and classroom observations. The chapter will begin with a description of the three case study participants along with how the TTPD Program was delivered. Then, the data analysis for each of the research questions will follow. A synthesis of the themes generated for each research question will be the basis for the summary at the end of the chapter.

Tech Teachers: Participant Descriptions

The Program served 13 teachers in the Spring semester of the 2014-2015 school year. Eleven of the Tech Teachers represented 13 of the elementary buildings in District 57. The other two elementary buildings were not represented during the time of this study due to one unfilled position and one maternity leave. Two middle school Tech Teachers also participated in the TTPD Program, representing two of the three middle schools in District 57. One middle school was not represented due to an unfilled position.

Three elementary Tech Teachers agreed to participate in the extended, case study portion of this study. Jean, Jess, and Grace represent three different elementary schools, and are unique in their personal interests, education and professional experience, and building-based responsibilities as Tech Teachers. The following sections provide a detailed description of each of the case study participants, using Jean, Jess, and Grace as pseudonyms to maintain confidentiality.

Jean

Jean loves spending time with family and friends, watching movies and participating in a variety of outdoor activities. She has been married for 20 years and has two teenage children. Her son graduated from high school in 2016 with plans to enter college in the fall, while her daughter will be a Junior in high school. After teaching in a large, urban public school system for 10 years, Jean stayed at home with her children when they were young. Her love for education and her own children prompted Jean to learn a great deal about brain development and neurology, areas she continues to pursue. Involvement in her children's early education led Jean to start teaching Kindermusik, an early education music and movement program, which she still does to this day.

Jean's first job as a Tech Teacher and her subsequent assignments as an elementary school teacher for grades 3, 5, and 6 put her Bachelor's degree in Elementary Education to work in the large urban school district for a total of 10 years. After almost another decade as a stay-at-home-mom, Jean returned to the classroom when her children were nine and six years old only to find that much had changed since her experience in education during the 1990s. Having worked

on school improvement plans and served as a curriculum coach in what seemed like a "previous life", Jean decided to return to school herself and "refresh her professional knowledge." With her Master's Degree in Educational Technology, Jean returned to full-time teaching in August of 2013.

Jean is now an Elementary Tech Teacher at a school with approximately 650 students and 34 teachers for Kindergarten through fifth grade. The 2014-2015 school year was Jean's second year in this position, having previous experience decades prior. In her building, each of the three Kindergarten classes have carts with 30 iPads. Grades 1-5 share two laptop carts each (10 total carts) and have three iPads in each classroom. Each teacher has a desktop computer at his/her desk. Jean finds her building leaders to be respectful and positive leaders who value innovation and personal responsibility.

Jean's Tech Teacher responsibilities include providing preparation time for classroom teachers by taking their students in 30-minute sessions to the school's computer lab. She serves 27 classes that visit the lab each week, and also provides assistance during intervention times each day for grades 2-5. Jean also hosts weekly enrichment time for higher performing 5th graders on Wednesday, Thursday, and Friday. Jean does not currently spend much time with push-in activities but frequently consults with classroom teachers on the technology they are using, have available, or might be interested in learning. She communicates with classroom teachers about the instruction she provides students in the lab to support and complement what they are doing in the classroom. Jean consults with the principal and assistant principal regularly regarding technology use as well as needs and is currently developing a form for teachers to use in evaluating online resource subscriptions they want. Jean provides guidance for selecting

technology tools purchased using building-level funds and spends an average of 2-3 hours per week on technology troubleshooting and maintenance.

Jess

Another participant in this case study, Jess, shares some similarities, personally, with Jean, but her experience and responsibilities are quite different. Jess is also married and has two children. Her boys, however, are six and five years old. She enjoys outdoor activities and yoga as well as her responsibilities as a Girl Scout Cookie Mom. Jess has worked consistently since 1999 with brief breaks when her children were born. Outside of work, Jess is attempting to learn Spanish, spending time with family, and trying new recipes from Pinterest.

Jess works in a new building in District 57 that houses 20 full-day Kindergarten classrooms with approximately 500 students and 24 teachers. The 2014-2015 school year was Jess's eighth year in this position, having previous experience as a classroom teacher for grades 2, 3, and 4. Because the building was newly opened in the Fall of 2014, it is equipped with many state of the art devices and resources for technology. Each classroom teacher, the Tech Teacher, and the music and physical education teachers have a set of 30 iPads in a Bretford sync cart, enabled with a MacBook Pro laptop. Therefore, each student is equipped with his or her individual iPad to be utilized throughout the school day, in addition to using one during technology classes, small group instruction, and stations during Center Time. Each classroom and flex area location has an Epson LCD projector, an Elmo document camera, an Apple TV, and a Smartboard. Each teacher has a desktop computer at his/her desk. Lastly, the Media Center has a digital camera and video camera available for use on a check-out basis.

Although Jess has served as a Tech Teacher in the district for eight years, she just completed her Master's Degree in Educational Technology in December of 2015, having relied on her Bachelor's in elementary education for the first 15 years of her career. Jess does have other leadership responsibilities in the district, including serving as the Attendance Committee Chair and a member of the Building Leadership Team. The building leadership in Jess's situation embraces technology in a different way, given the 1:1 iPad availability they have implemented since the building's opening.

Jess spends her time as a Tech Teacher differently than many of her counterparts in the district. Her administrators have allowed her to have a schedule that involves spending only 50% of her time with "traditional" Tech Teacher responsibilities, providing preparation time for staff by teaching sections of students in 30-minute increments. Jess then spends 20% of her time pushing into classrooms in a co-teaching role, 15% with technology maintenance, and 15% providing job-embedded technology professional learning for the classroom teachers.

Grace

Grace differs somewhat from Jean and Jess in her personal attributes, but her education, and Tech Teacher responsibilities are quite different. She loves music and plays the piano and the trumpet. When growing up, Grace played volleyball, basketball, and tennis. She was even the first female in her town to play football in eighth grade. Grace is married now with a 2-year old son and another son due in July of 2016. Religious faith is very important to Grace's family.

Grace's education resulted in a Bachelor's Degree in Special Education which landed her in various teaching positions for nine years before she joined Newton District 57. She taught in a

self-contained deaf and hard of hearing classroom for three years, as a hearing itinerant teacher for two years, and a special education teacher in a private school for four years. Using technology in her special education classrooms sparked her interest in educational technology. She returned to school and earned her Master's Degree in Educational Technology in 2010. This allowed Grace to obtain her current position as a Tech Teacher in Newton District 57, which she has held for two years. She has aspirations of developing educational apps, building her own computer, and returning to school for a Master's Degree in Graphic Arts.

Grace's school is on the Northeast side of town and houses approximately 400 students and 22 teachers of grades Pre-K through fifth. As with the other schools, the kindergarten classes each have an iPad cart for 1:1 implementation. The school has four additional iPad carts and six laptop carts that are available for checkout for the remainder of the faculty to share. There is not a clear message of encouragement from the building administrators for teachers to integrate technology, which influences Grace's Tech Teacher responsibilities.

Grace operates under a traditional schedule, like Jean and Jess, providing preparation time for the classroom teachers as she delivers technology skills lessons to the students for 30-minute periods. A major difference, however, is that Grace is not involved in any push-in activity with the teachers, nor is she supported in facilitating any technology professional learning for her colleagues. She is not involved in technology discussions in her building, with teachers or the administration. Grace spends any time that she is not assigned to classes maintaining the iPad and laptop carts. In several meetings, she mentioned that she has "free time" because of this arrangement. She has recently been asked to serve as a substitute teacher in her building and to lead student intervention groups.

All three participants in the case study are family-oriented female professionals with Master's Degrees in Educational Technology. They all served as classroom teachers before becoming Tech Teachers. The similarities stop there, however. Each of these three Tech Teachers has a distinctive role in her respective building with varied responsibilities and influence on technology integration.

Delivery of the Program

The Spring 2015 TTPD Program was originally scheduled to occur during half of the Tech Teachers' weekly PLC meetings and four half-day pullout sessions. The content of the program was designed to cover seven main topics related to technology integration. However, some minor changes to the planned program did occur. First, due to scheduling conflicts caused by state testing, the March meeting was cancelled. Even with this change, the group met during nine PLC meetings and six half-day pullouts for a total of 27 hours of professional development time from January to June. A second change to the program was the superficial presentation of the ISTE Implementation WIKI in favor of spending additional time on the ISTE Profiles for Technology Literate Students. Due to the teachers' interest in the ISTE Profiles, it was decided to spend additional time exploring that content after a basic introduction to the WIKI was provided.

Research Question #1:

Did the Spring 2015 TTPD Program change the Tech Teachers' knowledge and beliefs about technology integration?

Tech Teachers' Knowledge

The TTPD Program provided informational and practice sessions on a variety of technology related topics that changed the Tech Teachers' knowledge over the course of the semester. From January to June of 2015, the program covered the following topics:

1. ISTE Standards for Teachers
2. ISTE Standards for Students
3. ISTE Profiles for Technology Literate Students
4. Harris and Hofer's Learning Activity Types
5. The SAMR Model of Technology Integration
6. Adult Learning Theory
7. Instructional Design for Technology PD

The Tech Teachers showed areas of growth as evidenced by both the quantitative and qualitative data.

Quantitative Data

The Tech Teachers were asked to rate their knowledge and skills related to the seven TTPD Program topics using the following scale:

1 – No knowledge
2 – Basic working knowledge
3 – Basic knowledge and some application
4 – Advanced knowledge and some application
5 – Advanced knowledge and application

The pre- and post-survey data showed the most growth in the Tech Teachers' knowledge of the ISTE Profiles for Technology Literate Students and the SAMR model. The sample sizes were both very small, however, and the presence of outliers in a few of the topic responses resulted in a larger standard deviation. Also, the pre- and post-survey samples were of different

sizes due to the number of participants who chose to continue with the study until the end. As previously mentioned, the sessions were spread out and lasted deeper into the school year than was originally planned. For these reasons, I used the median calculations to assess growth. Table 7 shows the central tendency data for both the pre- and post-survey.

Table 7

Central tendency data for pre- and post-survey responses

Topic	Pre-survey (n = 13)			Post-survey (n = 8)		
	Median	Mean	Standard Deviation	Median	Mean	Standard Deviation
ISTE-T	3.00	2.62	1.21	3.50	3.13	0.93
ISTE-S	3.00	3.00	0.88	4.00	3.63	0.99
Profiles	1.00	1.85	1.17	2.50	2.63	0.99
LATs	1.00	1.46	0.93	2.00	2.13	0.78
SAMR	1.00	1.31	0.61	3.00	3.25	0.97
ALT	1.00	1.69	0.91	2.00	2.50	0.71
ID for tech	2.00	1.85	1.03	3.00	3.00	1.22

Because the median represents the middle value of all responses, the samples can be compared more accurately, despite their different sizes or any outliers that may have skewed the mean. The median value for every topic in the TTPD Program increased from the pre- to the post-survey, with the ISTE Profiles for Technology Literate Students and the SAMR Model showing the most growth. For these two topics, there was a jump from lack of knowledge in the pre-survey responses to knowledge *and* application in the post-survey. This was a greater growth than expected in relation to the TTPD Program's intended learning outcomes, especially when

compared to other topics whose ratings increased only knowledge or application, but not both. The Profiles increased from a median value of 1.00 to 2.50 while the SAMR Model increased from 1.00 to 3.00. The increase in the median value resulted from an increase in the Tech Teachers' rating of their knowledge of those topics. In both cases the pre-survey median value of 1.00 indicated that the middle number when all responses were considered revealed an overall lack of knowledge in that area. The post-survey median values showed that the middle number when all responses were considered indicated at least a basic knowledge, entering into some application as well.

While the increase in the median values from the quantitative data indicated more growth in the areas of the ISTE Profiles for Technology Literate Students and the SAMR Model, the qualitative data supported growth in knowledge of the ISTE Standards (for both teachers and students) and the SAMR Model.

Qualitative Data

Open-ended survey answers, meeting notes, discussion board contributions, and classroom observation notes supported the growth of knowledge in two areas covered during the TTPD Program: (1) ISTE Standards for Teachers (ISTE·T) and Students (ISTE·S); and (2) the SAMR Model of technology integration.

ISTE Standards for Teachers and Students. The first topics covered in the TTPD Program were the ISTE·T and ISTE·S standards (see Appendix C). A variety of qualitative data showed the Tech Teachers' growth in these areas of knowledge.

Some Tech Teachers began the program already professing their advanced knowledge and application of the ISTE·T, providing examples such as their use of the standards "in a course" or "in Graduate school" (open-ended pre-survey). They touted their use of the ISTE·S in lesson planning. The TTPD Program gave even the Tech Teachers who already had some knowledge a way to apply their knowledge in authentic contexts. It was through the group's discussions and activities in the TTPD sessions that the Tech Teachers started holding themselves and others accountable for the use of the standards not only in planning their own lessons but also in "helping (classroom) teachers meet those standards" (open-ended post-survey).

The simulated contexts provided in the TTPD Program also provided the Tech Teachers with opportunities to apply their knowledge. For example, when viewing video clips of teachers using technology in the classroom, the Tech Teachers were not only able to recognize the ISTE·T and ISTE·S Standards in action, but also generate suggestions for improving the lessons they saw. I heard statements in TTPD session discussions like, "She could have used technology more efficiently" or "I hope she talked to them about copyright and posting to YouTube." In another session, the Tech Teachers examined sample lesson plans from anonymous classroom teachers in our district who attempted to integrate technology in their lessons and were able to suggest modifications. One Tech Teacher cited the need for "interactivity with a video – it can't be just watching PBS Kids" (meeting document). In some cases they applauded the efforts of the teachers, stating, "I am glad (the teacher) is using a collaborative tool that lets her know what was done by each student" (meeting discussion). They had truly internalized what the standards called for and were able to offer suggestions with a fluency that comes from deep understanding.

Jean, Jess, and Grace's extensive discussion board responses and my observations of their lessons revealed growth in their knowledge and practice as well.

The three case study participants were asked to describe how their knowledge about ISTE standards had changed with the influence of the TTPD Program. Each referenced their use of ISTE·T and ISTE·S in their daily work as Tech Teachers, striving to meet the ISTE·T standards themselves, and use of the ISTE·S to guide student work. Jean went from "a general knowledge of the standards" to thinking about "whether or not there are areas within a sub-section (of a standard)" (discussion board) that she needed to cover at any given grade level. The specificity with which Jean wrote about and applied the standards was a result of her participation in the TTPD Program. Jess also stated that she already had knowledge of the standards, but that after the TTPD Program she was able to "explain them and assist others with their meanings" (discussion board). While Jean and Jess both showed growth, Grace experienced a greater change, having started with only an awareness of the existence of the standards. By the end of the TTPD Program, Grace admitted that she "still (has) to look up the standards" to apply them in her lessons (discussion board). Her most powerful statement, however, was that she wants to "teach teachers about the standards" (discussion board). That is a pretty big leap from barely knowing about the standards to wanting to teach others.

The three case study participants also invited me to observe their interactions with teachers and students. Each of their lessons differed in the application of the standards. For example, Jean allowed the classroom teacher that she worked with to practice her technology fluency. Before the lesson, Jean worked with the teacher to find technology resources, and then took small groups aside during class time so the teacher could use the technology pieces herself, knowing Jean would be there if she needed help. Whereas, Jess applied the standards to her own

work as she led a lesson in another teacher's iPad classroom. She fostered creativity in the students' writing, guiding them in using an app to create sentences with pictures. She also allowed them to share their sentences with the class via the Apple TV in the room, something that would have been logistically impossible with pencil and paper. Finally, Grace's beginning stages of applying the standards were evident in the computer lab lesson in which she worked with students in trouble shooting publishing software and printer problems. She shared a template with the students that she had created for them to fill in information about their assigned planet. Meanwhile, the classroom teacher worked separately with students who had already finished their projects. Whether they used the standards in a lesson they led personally, or they applied them to a classroom teacher's technology integration, the knowledge Jean, Jess, and Grace gained in the TTPD Program was evident in their classroom applications and with other teachers they mentored.

Summary – ISTE·T and ISTE·S. The quantitative and qualitative data provided evidence that the Tech Teachers' grew in their knowledge of ISTE·T and ISTE·S as reported in their self-assessments and as observed in their discussions and classroom behaviors. This growth was evident in not only the case study participants but also the group as a whole. The mixed method data also revealed the Tech Teachers showed knowledge growth on the topic of the SAMR Model; those data are presented next.

SAMR Model. The SAMR Model was introduced to the Tech Teachers mid-way through the TTPD Program. With 10 of the 13 participants having no prior knowledge of the SAMR Model, it was no surprise that data collected through open-ended post-survey questions, meeting notes, discussion boards, and classroom observations showed knowledge growth in this area. Figure 7 illustrates the components of the SAMR Model.

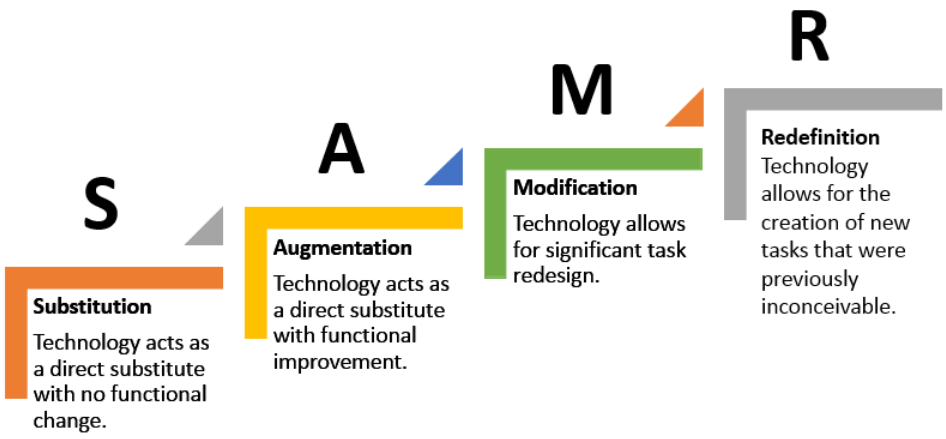

Figure 7: Dr. Ruben Puentedura's SAMR Model of technology integration

The open-ended post survey responses revealed the Tech Teachers, who previously knew nothing about the SAMR Model, were able to articulate their understanding of "the different levels" and "how to get to higher steps on the ladder" when asked for details of their knowledge of the model and how to apply it to lessons and/or activities. Three of the participants specifically referenced "incorporating it into next year's plan," "apply(ing) it to lessons and unit planning," and "us(ing) it with teachers" (open-ended post-survey). The apparent enthusiasm for the SAMR Model was also present in meeting discussions and documents where Tech Teachers applauded the SAMR Model as a "simple and easy to understand" framework that could be used to "help laypeople understand what educators are trying to do" (meeting notes).

The three case study participants share similar enthusiasm and opinions of the SAMR Model in their discussion board. Similar to their learning outcomes with the ISTE Standards, each of the case study participants landed in a different place with her knowledge and application of the SAMR Model. This time it was Jean and Grace who were ready to jump in and use the

SAMR Model with teachers while Jess wanted more time to deepen her knowledge before applying it to her work with teachers. For example, Jean's discussion board response revealed a detailed plan of how to use the SAMR Model while "pushing into (a teacher's) classroom over time…staying with one level until the teacher is proficient enough to implement on her own." Even though Jess's idea to "help teachers understand the levels and then delve into making changes in activities" (discussion board) is much like Jean's push-in plan, her statement that she "could use some additional training sessions" showed that she was not quite ready to take action. Grace, on the other hand, wanted to appeal to teachers by helping them "make (the) projects they like, using technology" with the hope that it could "start the process of changing their technology integration mindset" (discussion board). I saw the beginnings of Jean, Jess, and Grace's plans take shape when I observed them in the classroom.

As mentioned earlier, Jean, Jess, and Grace each had a different way of working with teachers and students during the lessons I observed. None of the case study participants explicitly addressed the SAMR Model in their interactions with teachers or students, but the application of their knowledge was clear from an observation standpoint. For instance, Jean helped the teacher with whom she was working to implement an "augmented" activity, using video as a substitution for lecture with the animations and graphics improving upon what may have traditionally been accomplished by drawing on a white board. In contrast, Jess worked directly with students to conduct a lesson that "redefined" how students created and shared their writing with the teacher and with each other. Using the iPads to construct sentences through an app that shared the sentences with the classroom teacher to later receive feedback was more of a "substitution" activity, using an electronic submission rather than pencil and paper. The activity redefined what students could accomplish through the use of technology by allowing them to share sentences

through the Apple TV display and receive feedback from their peers. A traditional activity may have encouraged students to exchange papers and correct each other's work, but the real time feedback opportunity that this activity provided could never be accomplished in the same amount of class time. In contrast to Jess's redefinition-level activity, Grace's lesson incorporated technology into a classroom teacher's traditional project at the "substitution" level. Grace created and shared an electronic template in which the students could enter their researched information about the planets. Even the research in this project was at the "substitution" level, swapping books or encyclopedias for a digital database. By removing old technology (pencil and paper) in favor of a computer printout, Grace provided the classroom teacher with an appealing alternative that allowed students computer practice time while providing the teacher with aesthetically pleasing student work. This activity showed Grace's attempt to ease the teacher into technology integration. Activities at all levels of the SAMR Model have a place in every teacher's repertoire as they advance in their technology integration skills. Jean, Jess, and Grace's work met the learners' needs and encouraged experimentation with technology at an appropriate level that was comfortable for the students and the teachers.

Summary – SAMR Model. Both the quantitative and qualitative data provided evidence that the Tech Teachers grew in their knowledge of the SAMR Model as reported in their pre- and post-surveys and as observed in their TTPD meetings and classroom applications. The increase in knowledge of the SAMR Model applied to the whole group of Tech Teachers and was specifically evidenced in the case study participants' classroom lessons. The TTPD Program played a role in increasing the Tech Teachers' knowledge of technology-related topics, and it also led to changes in their beliefs about technology integration. The next section addresses the

data collected in response to the second part of the first research question (i.e., Did the Spring 2015 TTPD Program change the Tech Teachers' *beliefs* about technology integration?).

Tech Teachers' Beliefs

The TTPD Program covered various topics that were intended to address the Tech Teachers' beliefs regarding technology integration. Considering adult learning theory and effective PD design as discussed in Chapter 2 (collaborative, job-embedded, etc.), the pre- and post-survey questions asked the Tech Teachers to rate their beliefs about a variety of statements regarding technology integration.

Quantitative Data

In the pre- and post-survey, Tech Teachers were asked to rank their belief standpoint on the following statements, with a ranking of 1 representing the statement with which they agreed the most and a ranking of 6 representing the statement with which they least agreed. In terms of leading to technology integration through effective professional development practices, statements C, D, and E provide ongoing, modeled, and collaborative professional learning opportunities. Statements A and B separate the learning about technology from the application and are less effective professional learning models in terms of likelihood of implementation. Option F excludes PD for teachers altogether and leaves the teaching of technology skills up to a technology specialist in isolation of the core curriculum, which, of course, is not integration at all. The statements A, B, and F are all more technocentric, focusing on technology tools rather than integration with the core curriculum. Table 8 provides a summary of each survey

Table 8

Pre- and Post-Survey Rankings of Technology Integration Belief Statements

I believe that technology integration is best accomplished through…	***Technology PD practices***	***Pre-survey ranking (n=9)***	***Post-survey ranking*** (n=5)
A. Conferences or workshops that provide a wealth of suggested applications for teachers to use in their classrooms.	Ineffective: technocentric, out of context	5	6
B. Brief sessions that focus on one tool at a time and give teachers hands-on time to practice.	Ineffective: technocentric	3	1
C. Ongoing sessions that build teachers' confidence with technology over time by providing not only hands-on time to practice but also follow up support for trouble shooting or other needs.	Effective: ongoing, hands-on, follow up	1	2
D. Observations of model lessons that incorporate technology into content-based lessons addressing the content standards.	Effective: collaborative, contextualized, ongoing	4	4
E. Co-planning and/or co-teaching with a technology specialist to integrate technology into a content-based lesson addressing the content standards.	Effective: collaborative, contextualized, job-embedded, ongoing	2	3
F. A technology specialist delivering a skills-based curriculum in isolation of content or curricular standards.	Ineffective: no PD provided, technology taught in isolation	6	5

statement's relation to effective technology professional development as outlined in Chapter 2 in addition to the pre- and post-survey rankings.

It is important to note that only nine TTPD participants answered this question on the pre-survey and five answered it on the post-survey, again, likely due to the timing of the post-survey at the very end of the school year. The quantitative data showed an effective PD format that remained unrecognized (statement D) and a less-effective PD format that gained support (statement B) even after the TTPD Program.

As far as the statements related to effective PD practices were concerned, the data showed that the Tech Teachers already agreed with statements C and E, ranking them in the top three in both the pre- and post-surveys. The other statement describing effective professional development for technology integration (statement D) had a ranking of 4 in both the pre- and the post-survey results, however, which indicated that the collaborative learning represented in that statement did not gain any favor with the TTPD participants. The division in the Tech Teachers' espousal of effective practices was mirrored in their rankings of the statements describing ineffective practices. That is to say that responses typically associated with traditional PD and more effective current PD practices were both present in the pre- and post-surveys. This division is echoed in the qualitative data as well.

The data showed statements A and F to be the least desirable options for achieving technology integration in both the pre- and post-surveys as indicated by rankings of 5 and 6. The PD format represented in statement B favored an ineffective focus on technology tools rather than how to use them, so its rise in the rankings from a 3 to a 1 contradicted not only the Tech Teachers' previously stated accord with statements C and D, but also a mismatch with their negative opinions of statements A and F. Both sets of statements showed an outlier ranking that coincided with the Tech Teachers' division of technology integration beliefs captured by qualitative sources as discussed in the next section.

Qualitative Data

The qualitative data that were gathered throughout the sessions painted a picture of the Tech Teachers' beliefs about how technology integration is achieved through different PD formats as divided into two opposite camps: a group with traditional beliefs valuing technocentric sit-and-get learning and a group that embraced research-based professional learning such as modeling and coaching.

The traditional technocentric practices in statements A, B, and F are similar to the "beginning of the year" and "staff meeting" opportunities of which some Tech Teachers were advocates during meeting discussions. Jean, one of the case study participants specifically mentioned providing "nuts and bolts knowledge" and helping classroom teachers develop their proficiency with personal productivity tools before moving on to integration with the core curriculum (discussion board). The importance placed on technology tools and teacher needs rather than integration were representative of the traditionalist views of a group of the Tech

Teachers. The references to such outdated ideas were outnumbered by the research-based practices mentioned by other Tech Teachers' comments that embraced collaborative *and* ongoing learning.

The majority of the comments (5 out of 7) regarding beliefs about effective technology integration practices centered on collaboration (meeting discussions and documents). The most common idea in their discussions was the need for "a push-in model for all of the Tech Teachers" to work with classroom teachers. This group also promoted the use of PLC meeting time over the course of the year to engage in collaborative planning with classroom teachers, ideally preceding the push into the classroom for a truly collective effort. Unlike the current model (as stated in the district's collective bargaining agreement) Tech Teachers provide preparation time for classroom teachers, this group suggested that the classroom teachers "should be contractually obligated to stay" and engage in the teaching of the lesson. It is evident from their statements that this group of Tech Teachers believed in collaborative, ongoing learning with their classroom teacher counterparts.

Even though Jean fell into the group of traditionalist support practices, Jess and Grace aligned more with research-based practices. First, Jess applied the knowledge she gained about adult learning principles by acknowledging the need for teachers to participate in "hands-on learning related to real-life experiences or need" (discussion board). Jess's mention of using "coaching, PLCs, modeling, and observations" matched with Grace's plan to "work alongside teachers." Grace alluded to the "bigger picture" of technology integration, utilizing the teaching of "frequent chunks of technology" coupled with side-by-side learning with classroom teachers to promote positive changes in their "technology integration mindset." The job-embedded

practices promoted by Jess and Grace paralleled the meeting discussion topics of the larger group of Tech Teachers with respect to research-based technology integration efforts.

Summary of Tech Teachers' Beliefs

The mixed method data relating to technology integration beliefs showed that the Tech Teachers remained divided in their ideas even after the TTPD Program. The ineffective, technocentric method of sit-and-get learning that was supported by the Tech Teachers in the survey went hand in hand with the opinions of the traditionalists as recorded during meeting discussions. The number of meeting remarks promoting collaborative, job-embedded learning practices, however, outweighed the post-survey responses and were supported by 2 of the 3 case study participants as well.

Asking for the Tech Teachers' opinions about practices leading to technology integration will make no difference in systemic changed if the need for organizational support was not also taken into consideration. My second research question asked the Tech Teachers to share their perceptions of organizational support.

Research Question #2:

What are the Tech Teachers' perceptions of organizational change
and support as the district progresses toward the implementation of a TIS Program?

It should be noted at this point in the data analysis that the district administration did not allow me or my co-presenter to mention the move to a TIS system during our time with the Tech

Teachers. Due to controversial contract negotiations and district climate at the time of the TTPD Program, the conditions were not conducive to proposing such a radical change in job responsibilities for the Tech Teachers. Knowing about the district's intention to make future changes may have produced different results for all data collected in response to research questions 2 and 3.

Perceptions of Support

The TTPD Program was designed and delivered with the intention of transitioning to a TIS program for the 2015-2016 school year. While the Tech Teachers were not explicitly told of any impending change, it was apparent in meeting discussions that many of the Tech Teachers were in favor of a push-in model to collaborate with their colleagues. The question of organizational support revealed the Tech Teachers' perceptions of building and district support for the role of a TIS (even though we did not name the program or responsibilities specifically).

Quantitative Data

In pre- and post-surveys, the Tech Teachers were asked to rate their agreement with statements about organizational support using the scale:

1. Strongly Agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree

The survey questions were created based on Guskey's third level of professional development evaluation: Organization Support and Change. As referenced in Chapter 2, there are nine areas of organizational support that can be evaluated for any professional development program. The questions in the pre- and post-survey that the Tech Teachers answered were limited to five of those areas, bolded in the list below.

a. Organization policies
b. Resources
c. Protection from intrusions
d. Openness to experimentation and alleviation of fears
e. Collegial support
f. Principal's leadership and support
g. Higher-level administrators' leadership and support
h. Recognition of success
i. Provision of time (Guskey, 2000, p. 152)

As with the data set for the Tech Teachers' knowledge growth under research question number 1, I again used the median value to determine change in the perceptions of organizational support. Also like the previous data set, the sample size was different in the pre- and post-survey, but this time only by one respondent. Because the pre-survey was administered under the time constraint of a 40-minute meeting, I believe the number of pre-survey respondents dropped from 13 (number of respondents to survey questions related to research question number one) to 9 (number of respondents to survey questions related to research questions two and three) because the Tech Teachers ran out of time to complete all the questions. The number of post-survey respondents remained constant for all of the post-survey questions because we allowed the participants more time to complete the survey.

In looking at the quantitative data regarding the Tech Teachers' perceptions of organizational support, their beliefs in two areas (*support* for push-in and *time* to work with staff)

decreased over the course of the TTPD Program. The change from 1.00 to 2.00 meant that the Tech Teachers decreased their agreement with the statements about push-in support from "Strongly Agree" to "Agree." The change from 3.00 to 4.00 concerning the perception of the availability of time to work with classroom teachers shifted from "Neither Agree nor Disagree" to "Disagree." Even though 2 of the 5 areas of organizational support were perceived to be less supported by the end of the TTPD Program, one area (dependability of TTPD Program providers for support) increased from "Agree" to "Strongly Agree" according to the change in median scores from 2.00 to 1.00.

The remaining two areas (protected scheduling and collegial support) questioned in the pre- and post-survey showed no change in the Tech Teachers' perceptions of support. The Tech Teachers' perception of support in the areas of protected scheduling and collegial support remained constant from January to June. Although there was no change in the perception of support for protected scheduling, it should be noted that the median rating of 3.00 indicated neither agreement nor disagreement with the statement. Table 9 provides a summary of this information.

The perception of a lack of support in providing time for the Tech Teachers to work with classroom teachers also appeared in the qualitative data, along with other areas of organizational support that were not addressed in the pre- and post-survey questions.

Table 9

Pre- and Post-Survey Central Tendency Data for Organizational Support

	Pre-survey (n = 13)			Post-survey (n = 8)		
	Median	Mean	Standard Deviation	Median	Mean	Standard Deviation
I feel that I have the support of my building administrator to protect my schedule from inclusion of duties that are unrelated to Instructional Technology support. (c. Protection from intrusions)						
	3.00	2.77	0.93	3.00	2.75	1.28
I feel that I have the support of my building administrator to push-in to the classroom without being asked for confidential information about a teacher's performance. (f. Principal's leadership and support)						
	1.00	1.54	0.66	2.00	2.00	1.07
I feel that I can depend on my colleagues from this program to continue a professional learning network in which we share ideas, lessons, etc. to help all teachers in all buildings. (e. Collegial support)						
	2.00	2.00	0.58	2.00	2.00	0.76
I feel that I can depend on the Curriculum Technology Facilitator or Professional Development Coordinator to continue to build upon and refine my skillset as a Technology Integration Specialist. (g. Higher-level administrators' leadership and support)						
	2.00	1.69	0.63	1.00	1.38	0.52
I feel that I will have adequate time to work with the staff in my assigned building(s) over the course of the year to develop both teacher and student proficiencies with Instructional Technology. (i. Provision of time)						
	3.00	2.77	0.73	4.00	3.88	1.13

Qualitative Data

Many comments surfaced from the participants regarding their perceptions of organizational support for current and future technology integration support efforts. The Tech Teachers' comments in meetings aligned with their pre- and post-survey answers, but also revealed their perceptions of additional aspects of organizational support that were not addressed in the survey questions. The three themes of the Tech Teachers' perceptions include *collegial support*, *provision of collaborative time*, and *administrative support*.

Collegial Support. The qualitative data corroborated the Tech Teachers' agreement in terms of support within their own Tech Teacher group and also shed light on an additional interpretation of collegial support. The Tech Teachers who participated in the case study portion of the research submitted the most powerful statements of collegial support. Jean and Jess both mentioned through the discussion board that they knew they could "count on the Tech Teacher group" to continue their learning about technology integration. Although the discussion board responses submitted by the case study participants upheld the consistent rating of "Agree" for the statement "I can depend on my colleagues from this program to continue a professional learning network in which we share ideas, lessons, etc. to help all teachers in all buildings," meeting discussions with the whole group of Tech Teachers took a different direction, bringing up divergent thoughts about collegial support when considering teachers outside of the Tech Teacher group.

The survey question asked the Tech Teachers to specifically consider collegial support from their colleagues in the Tech Teacher group. Meeting discussions, however, revealed that collegial support from *classroom teachers* was an area for improvement when considering

organizational support. For example, in one PD meeting discussion, a Tech Teacher proclaimed, "We need district-level support to clarify the nature of the Tech Teacher position for others. We are not just specials teachers." This comment inspired another Tech Teacher's emotional declaration, "We need to demand respect for ourselves as facilitators of PD," followed by "Teachers de-value our position." The central message of these comments was that the Tech Teachers did not feel supported by their non-Tech Teacher colleagues. They also felt a lack of support with respect to the amount of collaboration time they are provided to work with classroom teachers.

Provision of Collaborative Time. Qualitative data from PD meeting discussions paralleled the Tech Teachers' shift to "disagreement" when considering organizational support in the form of time provided for collaboration with classroom teachers. One example was a Tech Teachers' simple but clear assertion that "(working with classroom teachers) is hard to do with the time we have." Similar comments were spread throughout the PD sessions, always resulting in the other Tech Teachers nodding in agreement or providing an emphatic "yeah" in solidarity.

Meeting discussions and case responses also revealed one of Guskey's elements of organizational support that was not addressed in the survey questions – higher-level administrative support. As with the question that asked the Tech Teachers to rate collegial support specifically from other Tech Teachers, the survey questioned higher-level administrative support only from the TTPD Program providers. While the Tech Teachers felt supported by the TTPD Program providers, their meeting discussions indicated a desire for greater support from district-level administration in general.

Administrative Support. Going beyond building-level support and that of the TTPD Program providers, one Tech Teacher insightfully wrote in an anonymous online response during

a meeting, "If we don't have the combined support by the Admin, Tech Dept., School Staff, and have the equipment needed, then (district-wide technology integration) won't work." Another response to the online discussion during the same meeting read, "The administration needs to create a culture that values technology." The Tech Teachers' contributions to online discussions during TTPD meetings showed their perception of a lack of system-wide administrative support that was echoed in the case study participants' discussion board submissions.

Two of the three case study participants also expressed concern in the area of higher-level administrative support. Jean and Jess saw the big picture for technology integration, reaffirming the meeting discussion commentaries. Jean called for a model to follow based not only on a framework but also on observations and consultations with other districts that have successfully implemented a TIS program. Jess was of a similar mindset, suggesting the need for a "district technology plan with vision and goals" to create teacher buy-in and generate community support. Grace, on the other hand, did not address system-wide support as she focused her concerns about support at the building level, providing examples of inconsistency in expectations for technology integration as well as equitable access to technology. She cites the different technology hardware available to each building as well as each individual principal's discretion about their Tech Teacher's schedule as contributors to inconsistency that is not addressed at a system-wide level.

Summary of Perceptions of Support. Overall, the quantitative data showed a decrease in the perception of support in the areas of (1) support for pushing into the classroom and (2) provision of time to work with classroom teachers. The Tech Teachers' perception of support from the TTPD Program providers increased, however. The qualitative data revealed the Tech Teachers' positive feelings of support within their own group in stark contrast to the lack of support they perceived from their classroom teacher colleagues. Also in comparison to high-level

of support the Tech Teachers felt from the TTPD Program providers, their comments about other higher-level administration showed a need for more system-wide support with suggestions for a district technology plan that would communicate the value of technology.

In addition to the Tech Teachers' knowledge and beliefs and the need for organizational support to make improvements in technology integration efforts, the Tech Teachers would need to apply what they learned and believe into their daily practices. My third research question sought an understanding of the Tech Teachers' views on their own abilities to fulfill the responsibilities of a TIS.

Research Question #3:

Do the Tech Teachers feel that the PD Program provided them with the necessary skills to participate successfully in the TIS Activity System?

The purpose of the Tech Teacher PD Program was to begin preparing the Tech Teachers with the knowledge and skills necessary to take on the responsibilities of a TIS when the change was made. Remember, however, that we were not able to speak directly about the district's intention to change to a TIS program, including any specific responsibilities included in a potential TIS job description. The Tech Teachers answered the questions related to research question number three as a simple self-evaluation.

Quantitative Data

The sections of the pre- and post-survey questions related to the necessary skills to participate successfully in a TIS program were based on the ISTE·T and ISTE Standards for Coaches (ISTE·C). Those were the standards used to create the TIS job description proposal submitted with the transition plan in November of 2014.

In pre- and post-surveys, the Tech Teachers were asked to rate their agreement with statements about their abilities to support classroom teachers using the scale:

1. Strongly Agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree

Note that the last survey question was extracted from the ISTE·C and included in this section due to its specific reference to assisting teachers. Table 10 provides a summary of the data.

The median ratings for all but one of the statements relating to assisting classroom teachers with technology integration showed a decrease in agreement from the beginning to the end of the TTPD Program. The one statement that remained in absolute *strong agreement*, as indicated by the rating of 1.00, was "I believe I can assist classroom teachers in promoting and modeling digital citizenship and responsibility." All other statements' ratings decreased from 1.00 to 1.50 except "I believe I can assist classroom teachers in facilitating and inspiring student learning and creativity." This statement slipped from 1.00 to 2.00 showing only *agreement* after the TTPD Program. This section of the survey emphasized the Tech Teachers' beliefs about their abilities to assist classroom teachers which will ultimately be a TIS responsibility. Other items in

the TIS job description that are more global in their scope were addressed by statements related to the ISTE·C Standards in the next section of the survey.

Table 10

Central tendency data for pre- and post-survey responses – Supporting classroom teachers

	Pre-survey (n = 9)			Post-survey (n = 8)		
	Median	Mean	Standard Deviation	Median	Mean	Standard Deviation
I believe I can assist classroom teachers in facilitating and inspiring student learning and creativity. (ISTE·T, 1)						
	1.00	1.33	0.47	2.00	1.63	0.48
I believe I can assist classroom teachers in designing and developing digital age learning experiences and assessments. (ISTE·T, 2)						
	1.00	1.33	0.47	1.50	1.50	0.50
I believe I can assist classroom teachers in modeling digital age work and learning. (ISTE·T, 3)						
	1.00	1.22	0.42	1.50	1.50	0.50
I believe I can assist classroom teachers in promoting and modeling digital citizenship and responsibility. (ISTE·T, 4)						
	1.00	1.33	0.47	1.00	1.38	0.48
I believe I can assist classroom teachers in engaging in professional growth and leadership regarding technology integration. (ISTE·T, 5)						
	1.00	1.67	0.94	1.50	1.50	0.50
I believe I can assist classroom teachers in using technology effectively for assessing student learning, differentiating instruction, and providing rigorous, relevant, and engaging learning experiences for all students. (ISTE·C, 2)						
	1.00	1.56	0.83	1.50	1.63	0.70

In the pre- and post-surveys, Tech Teachers were asked to rate their agreement with statements about their abilities to fulfill the TIS role using the scale:

1. Strongly Agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree

Note that the last standard is separated into two statements due to its multi-faceted nature.

Looking once again at the median scores, the quantitative data showed only one change in the Tech Teachers' perceived abilities to fulfill TIS responsibilities. In the pre-survey, the median rating of 1.00 indicated *strong* agreement with the statement "I believe that I personally am continuously deepening my knowledge and expertise in the area of educational technology." After five months of the PD Program, the median rating showed only *agreement* with the same statement. This decrease in agreement is in contrast to the consistent median rating for every other question in this section of the survey. All of the quantitative data indicated that the Tech Teachers felt confident (agreeing or strongly agreeing) with all of the potential TIS responsibilities. The qualitative data, however, provided very little support of the statements from the pre- and post-surveys. Table 11 provides a summary of this data.

Table 11

Central tendency data for pre- and post-survey responses – TIS responsibilities

	Pre-survey (n = 9)			Post-survey (n = 8)		
	Median	Mean	Standard Deviation	Median	Mean	Standard Deviation
I believe that I personally have the visionary leadership to participate in the development and implementation of a shared vision for the comprehensive integration of technology to promote transformational change throughout the instructional environment. (ISTE·C, 1)						
	2.00	1.89	0.99	2.00	1.75	0.66
I believe that I personally can create and support effective digital age learning environments to maximize the learning of all students. (ISTE·C, 3)						
	2.00	1.67	0.47	2.00	1.75	0.43
I believe that I personally can conduct needs assessments, develop technology-related professional learning programs, and evaluate the impact on instructional practice and student learning. (ISTE·C, 4)						
	2.00	2.44	0.83	2.00	2.38	0.99
I believe that I personally can effectively model and promote digital citizenship. (ISTE·C, 5)						
	1.00	1.33	0.47	1.00	1.38	0.48
I believe that I personally can demonstrate professional knowledge, skills, and disposition in content, pedagogical, and technological areas as well as adult learning and leadership. (ISTE·C, 6)						
	2.00	1.78	0.92	2.00	1.63	0.48
I believe that I personally am continuously deepening my knowledge and expertise in the area of educational technology. (ISTE·C, 6)						
	1.00	1.56	0.68	2.00	1.63	0.48

Qualitative Data

The qualitative data to support the Tech Teachers' ability to fulfill the TIS role were challenging to uncover. There were no specific references to any of the items in the survey statements, but rather general assertions in PD meetings such as, "Let's change our job titles to Technology Integration Specialists," and "We, as Tech Teachers, need to be used as Technology Integration Specialists." In talks about assisting classroom teachers, the Tech Teachers said they wanted "to be more in the classroom," and they also expressed their desire to "collaborate on lessons." Finally, one Tech Teacher announced that "PD should be done in each building by the Tech Teacher." While all of their statements fall under the responsibilities of a TIS, none of them were as specific in nature as the survey questions.

Also vaguely connected to the TIS responsibilities, Jean and Jess referred to their personality traits (social and collaborative) as the basis for their feelings of preparation. Unfortunately, Grace had not had the ability to create relationships with the classroom teachers in her building because they "follow suit with the top-down tone of the building." She allowed her perception of organizational support to overshadow her feelings of preparation, neglecting to answer the question directly. All three mentioned using what they learned in the TTPD Program to help other teachers but failed to include examples that could be matched up to the survey statements.

Summary of Feelings of Preparation

Without the knowledge of the TIS responsibilities listed in the proposed job description, the Tech Teachers' reporting their feelings of preparation only provided superficial data to inform decision making about future PD or other decisions regarding the implementation of the TIS program. The absence of qualitative data to support the assertions of the pre- and post-surveys made it difficult to take the Tech Teachers' self-ratings at face value. In relation to the implementation of the TIS program, my last research question was designed to analyze the intersystem interactions before, during, and after the TTPD Program.

Research Question #4:

What are the complementary and contradictory intersystem interactions that manifest during the progression of the Tech Teacher through the three activity systems?

As mentioned in previous sections of this chapter, the Instructional Technology Coordinator and I were not allowed to share any information about the TIS position with the Tech Teachers during our TTPD Program. The Assistant Superintendent to whom we proposed the TIS job description and the implementation plan did not allow us to share the information because the district was undergoing contract negotiations for the upcoming school year. Making the Tech Teachers question their job security in any way could have resulted in problems with negotiations and contributed even more to the negative climate that was developing in the district as the first contract ratification failed and negotiations continued. Because proposed contracts

continued to be rejected by union membership and negotiations continued well into the Spring of the 2015-2016 school year, the Tech Teacher position never did transition to a TIS program.

Activity Systems Analysis

The use of activity systems analysis in this study was limited to the examination of the first two activity systems (i.e. before and during the TTPD Program) due to the district circumstances previously described. The study did provide a great deal of data regarding the Tech Teachers' knowledge, beliefs about technology integration and organizational support, and their feelings of preparedness to fulfill TIS responsibilities that are analyzed in the following sections. Remembering that activity systems analysis is used to observe the interactions of elements within and across activity systems, I will first address the elements and tensions of each of the two systems and then provide an intersystem interaction analysis.

Systemic Tensions

Tensions arise as the actions within a system unfold. These tensions may influence the interactions among the elements of the system and may also affect the outcomes, either positively or negatively. The tensions of the first activity system were identified through personal conversations with the Instructional Technology Coordinator during the planning stages of our TIS Program proposal. The tensions in the second activity system relate directly to the data collected during the study and affirm the quantitative and qualitative data already discussed.

System 1 – Current Reality of Instructional Technology Activity System. At the onset of this study, there was an activity system in place in which all elements were interacting. In

Chapter one, the model for this system was represented by Figure 2. Within the system there were already some tensions at work that were explained to me by the Instructional Technology Coordinator in our planning meetings. She provided me with relevant background information as a new employee in the district so our TTPD Program would be grounded in an understanding of the participants' professional context. For example, the *rules* in place for each of the participants in the study were not consistent from building to building. Some Tech Teachers had more time than others to push in to classrooms even before the TTPD Program. Some Tech Teachers' lab schedule and "other duties as assigned" were focused on technology integration tasks rather than subbing for classroom teachers and providing reading interventions to struggling students. This tension is represented by the dashed line connecting *rules* and *object/outcomes* in Figure 8.

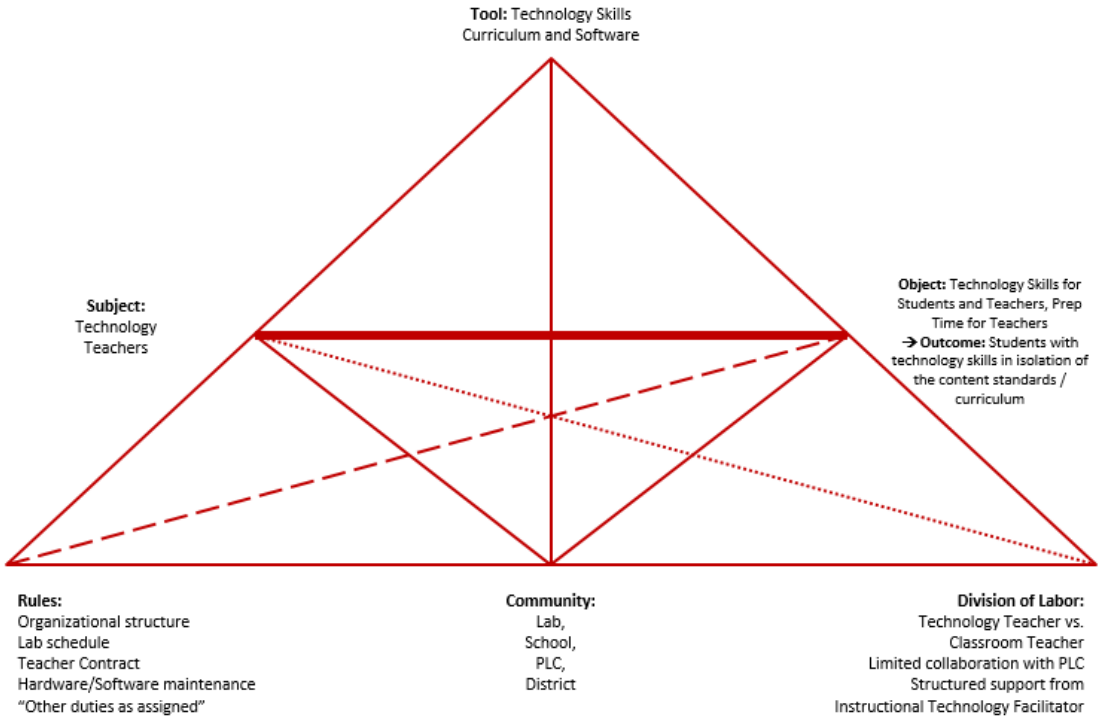

Figure 8: Activity System Prior to the TTPD Program Implementation with Tensions

Another tension that existed in the activity system prior to the TTPD Program occurred between the Tech Teachers as *subjects* and other individuals in the *division of labor* element. While some Tech Teachers had developed positive working relationships with their classroom teacher counterparts, others had significant work to do in this area. Additionally, the Tech Teacher PLC had been run very loosely prior to our implementation of the TTPD Program during the meetings. The Tech Teachers often used their PLC time as a forum to discuss personal professional struggles and troubleshoot technology maintenance issues. The interactions with classroom teachers and with each other in this original activity system was a greater tension than the *rules-object/outcome* tension and such is represented by the dotted line in Figure 8 to show the weakness it caused within the system.

Finally, the bolded line connecting Tech Teachers as *subjects* directly to the *object/outcome* in this system illustrates the strong connection between what the purpose of the Tech Teacher position was and the overall outcome of the system. While there were tensions that influenced the interactions in the system, it was ultimately serving its intended purpose of providing prep time to classroom teachers and technology skills to students. It was the *object/outcome* of this system that we aimed to change with the TTPD Program and TIS Program implementation.

System 2 – Activity System During the TTPD Program. The basic representation of the elements of the activity system in place during the TTPD Program was previously illustrated by Figure 3. There were tensions between some of the elements of this system that affected the overall outcome of this activity system. Some tensions were minor, but other major tensions are associated with the eventual derailment of the TIS program implementation.

Minor Tensions. Two of the connections showed minor tensions and are represented by a dashed line in Figure 9: the *rules* and *object/outcome* connection and the *subject* and *division of labor* connection. These tensions occurred with two major *rules* in the system and between the Tech Teachers and two other groups represented in the *division of labor*.

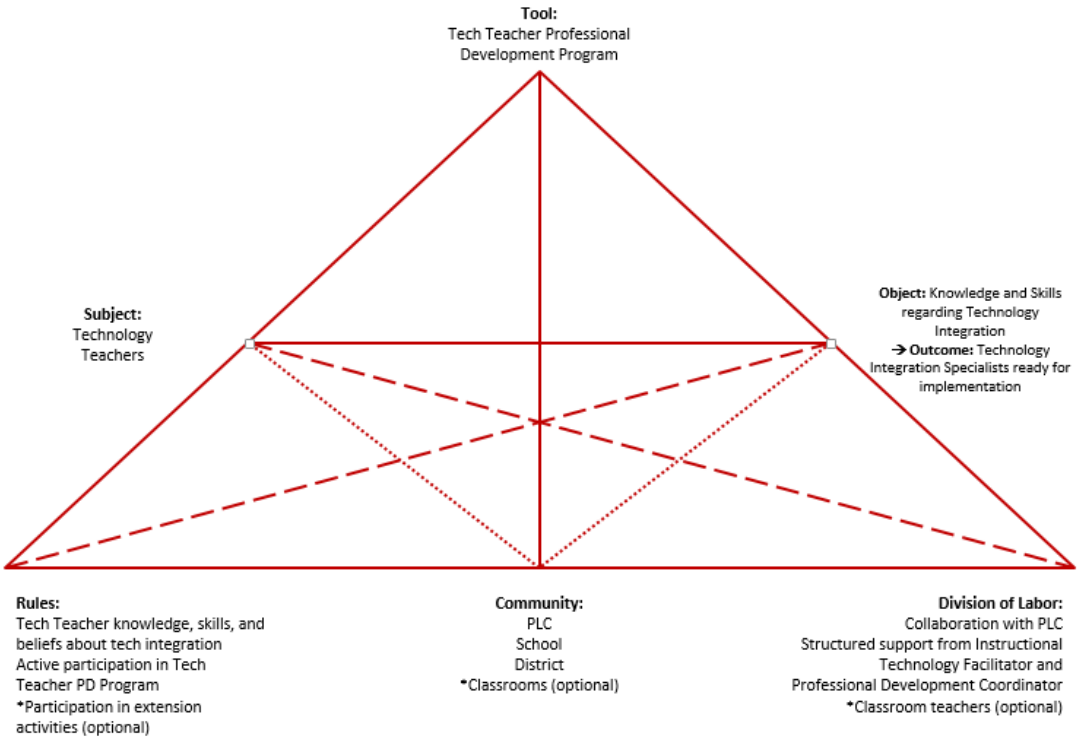

Figure 9: Activity System during the TTPD Program with Tensions

Rule 1: Tech Teachers' Knowledge, Skills, and Beliefs About Technology Integration.

The first *rule* to show tension in relation to the system *object/outcome* was the Tech Teachers' Knowledge, Skills, and Beliefs associated with their participation in the TTPD Program. Pre- and post-survey results showed an increase in knowledge and skills among the Tech Teachers, with the most growth related to the ISTE standards and the SAMR model. There were seven topics addressed in the TTPD Program, however, thus suggesting a tension impeding deep learning for

all of its curriculum components. The skills of the Tech Teachers were assessed in the pre- and post-survey and showed no change in their perceptions of their own abilities to fulfill TIS responsibilities, indicating the absence of influence from the TTPD Program in this area. In terms of the Tech Teachers' beliefs about technology integration, the lack of positive change in their beliefs about effective technology PD models by the end of the TTPD Program is perhaps the largest contributor to the weakened connection between the *rules* and *object/outcome* of this system.

Rule 2: Active Participation in the TTPD Program. While most Tech Teachers "actively participated" in the TTPD Program, attending meetings and taking part in the planned learning activities, there were occasional absences with no make-up expectations. Tech Teachers who attended took part in various online forums to contribute to the group's understanding of the TTPD topics. Because there was no way to ask the absent teachers to make up the work at another time, their learning may have suffered. Additionally, there was a clear decrease in participation at the end of the program as noted by the drop in the post-survey *n* to 8 from 13. Although there were 12 Tech Teachers present at the last session of the TTPD Program, the timing of the session (held on the last teacher work day of the year) was less than ideal for the participants. The post-survey for the TTPD Program was administered through an online link that was emailed to participants at the end of the session. The fact that only 8 of the 12 Tech Teachers present chose to respond to the survey (and some did not even respond to all of the questions) may have been the result of their dwindling interest in the program. With tensions present in the *rules* and *object/outcome* connection, other tensions in the system come as no surprise.

A second weak connection due to tensions was observed between the Tech Teachers as the *subject* and other groups in the *division of labor* in the activity system during the TTPD Program. While the content and structure of the Tech Teachers' PLC meetings became more focused on teaching and learning, the quantity and quality of TIS-type responsibilities practiced by the case study participants showed a need to examine the tensions in this area.

PLC Structure. As seen in the activity system prior to the TTPD Program, the PLC meetings were not focused on student or adult learning. During the TTPD Program, however, the meetings took on a purpose and a structure that promoted adult learning that would positively impact student learning over time with the implementation of a TIS program. The PLC meetings became an opportunity to gain knowledge and skills in one week and apply them in the next. This learning and application was evident in the post-survey data showing growth in the Tech Teachers' knowledge, especially in the areas of the ISTE Standards and the SAMR Model. The knowledge gains could have been greater, as mentioned in the *rules* section previously, but the general impact of the tensions in the interactions between the Tech Teachers and the PLC group activities had a positive impact on the *object/outcome* of the activity system.

Work With Classroom Teachers. Not all of the interactions between the Tech Teachers as the *subject* of the activity system and the *division of labor* groups was positive, however. Only 3 of the 13 Tech Teachers participated in the extended case study portion of this research. This limited number, although reasonable for a case study, suggested a lack of interest, time, or other factors that would lead to successful TIS work in the future. Perhaps more important than the low number of case study participants, the purpose of some of the interactions I noted in classroom observations did not appear to lead to effective technology integration. Jean's taking part of the class to provide hands-on instruction with manipulatives while the classroom teacher

played a video for her students was a task that could have been completed by a teacher's assistant. Grace's lesson in the computer lab with students allowed her to demonstrate competency in troubleshooting hardware issues when the printer was not responding and showed her ability to create templates in presentation software, but it limited the students' interaction with technology to a simple substitution of typing instead of writing by hand. The intentions of practicing TIS responsibilities in collaboration with classroom teachers were clearly positive, but the way in which the activity was shared among the Tech Teachers and the classroom teachers showed minor tensions that weakened the connection between the *subjects* and the *division of labor* in this system.

Major Tensions. Unfortunately, not all of the tensions in this activity system were minor. Major tensions between the elements of *subject* and *community* and *community* and *object/outcome* were found in the activity system that occurred during the TTPD Program. The dotted lines in Figure 9 represent the weakened connections. The use of dots rather than dashes shows that the tensions among these connections had a stronger effect on weakening the activity system.

Subjects and community tensions. First, the tensions between the Tech Teachers as *subjects* and the *community* including classrooms, schools, and the district as a whole were evident in the meeting discussions and discussion board contributions. Tech Teachers often articulated the lack of organizational support they felt from their classroom teacher colleagues and their building administrators. Their demand for respect and more consistency in the responsibilities assigned by their building administrators was not questioned through the pre- and post-surveys, but rather emerged as themes when coding the qualitative data. Similarly, the lack of district-level vision and support for technology integration revealed additional tension

between these two elements. The tensions between *subjects* and *community* may have been closely related to the tensions between *community* and the *object/outcome* of the activity system during the TTPD Program.

Community and object/outcome. The *community*, specifically the district-level administration, provided the greatest tension within this system and possibly led to the failure to achieve the desired outcome of implementing a TIS program. The Instructional Technology Coordinator and I were explicitly told on various occasions by district-level administration that we could not communicate the true intentions of our program to eventually replace the Tech Teacher position with the TIS position at all K-8 schools. This lack of transparency has often been a complaint of one *community* representative group that I had not initially included in the activity system – the teachers' union. The relationship between the district administration and the teachers' union was extremely strained during the time of contentious contract negotiations and constant teacher complaints at school board meetings that aligned with the timing of the TTPD Program. While none of the conversations between the administration and the teachers' union were directly related to the TTPD Program or potential TIS program, the general atmosphere of distrust and animosity prevented the success of this activity system's intended *outcome*.

Systems 1 and 2 – Intersystem Tensions. Third-generation Activity Theory suggests that all activity systems are connected to or part of other systems in some way (Ball Anthony, 2012). While this study cannot achieve its complete goal of identifying the complementary and contradictory intersystem interactions among the three proposed activity systems, this section will describe the interactions between the first two systems. The complementary interactions are depicted with green lines in Figure 10 while contradictory interactions are represented with dashed or dotted lines in red or black depending on the degree of their influence.

Complementary Interactions. Some of the interactions between the first and second system were connections that provided a positive impact on the achievement of the *object/outcome*, referred to as complementary interactions. The element of *subject* remained the same from the first to the second system, providing a group of individuals who already understood the district context that would simply gain knowledge and skills under the activity system during the TTPD Program.

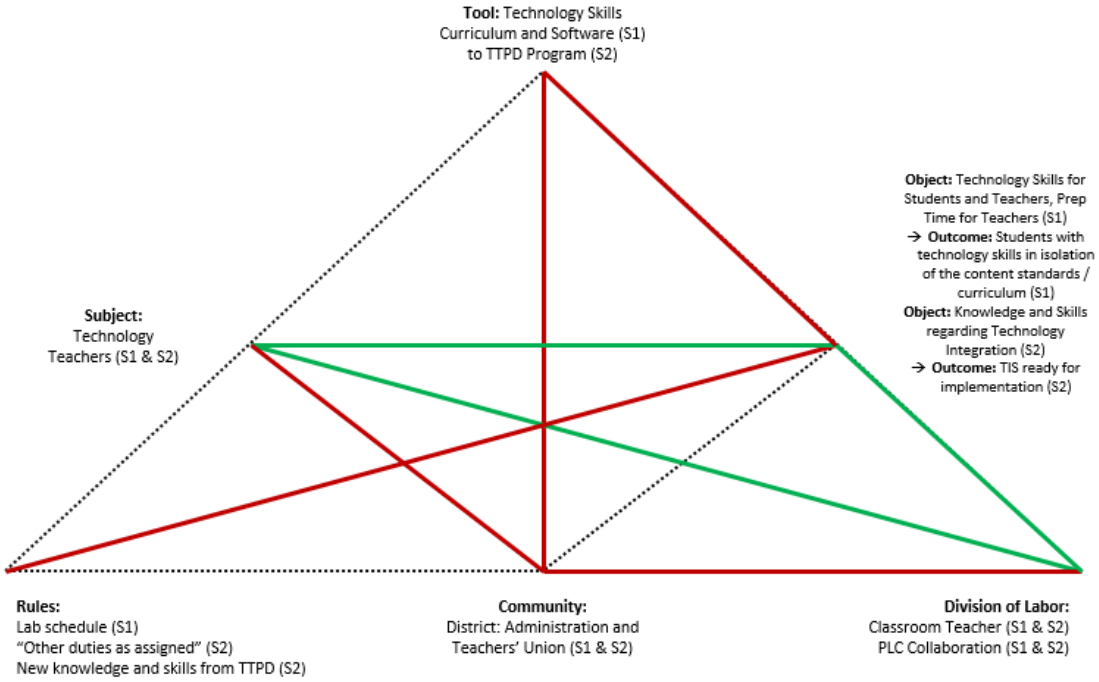

Figure 10: Intersystem Interactions between Activity Systems before (S1) and during (S2) the TTPD Program

Having learners who already knew their colleagues, students, and administrators was an obstacle that the TTPD Program did not need to overcome. The *subject* in the first system attained new knowledge and skills in the second system along with the opportunity to apply them to practice.

The second activity system also provided the *subject* with the opportunity to further explore the *division of labor*, involving the Tech Teachers in the case study and classroom

teacher colleagues to partner in practicing TIS-type collaboration on the design and execution of a content-based lesson. Another aspect of the *subject* and *division of labor* connection between systems that promoted a positive *object/outcome* was the reinforcement of the bond among the Tech Teacher PLC members (participants in the TTPD Program) who indicated a clear understanding of the value of the professional relationships within Tech Teacher PLC. This strong relationship among the group members provided an atmosphere conducive to learning during the TTPD meetings of the second activity system.

Contradictory Interactions. Unfortunately, not all of the intersystem interactions in this study promoted the attainment of the second system's *objective* of having trained TIS ready to begin the third activity system (implementation of the TIS Program in the district). From system one to system two, the changes in the *tool* and *object/outcome* in the system during the TTPD Program can be associated with the modified *rules* and role of the *community* in the second system that ruined the possibility for the TIS program implementation.

Tools and rules. The introduction of the TTPD Program in the second activity system provided for changes in the *rules* that governed the actions of the *subject*. The Tech Teachers were exposed to new knowledge and skills that challenged the status quo and made them start to question the relevance of the Tech Teacher position as it existed in the first activity system. The TTPD Program as a *tool* in the second system allowed the Tech Teachers to move beyond the role of provider of isolated technology skills.

Object/outcome and community. The *community* did not demonstrate any resistance to building the Tech Teachers' knowledge and skills with the new *tool* of the TTPD Program. The intended *outcome* of having TIS ready to take on a new set of responsibilities for the following school year, however, did suffer an untimely termination at the hands of the *community*,

including the district administration's lack of transparency about the possibilities of the TIS program implementation and their antagonistic relationship with the teachers' union. Even though the *community* in the first activity system did not encourage innovative practices by the Tech Teachers, the second system specifically prohibited them from moving forward by postponing indefinitely the intended *outcome* of implementing the TIS program.

Summary of Activity Systems Analysis

In examining the first and second activity systems in this study independently, both had tensions present that affected interactions within the system. The first activity system (prior to the TTPD Program) experienced minor tensions that did not change the intended object/outcome of the system. In contrast, the tensions in the activity system during the TTPD Program resulted in the eventual failure to meet the intended outcome of the system. Together, the tensions between systems 1and 2 show both complementary and contradictory interactions. The unfortunate overall outcome, however was thwarted by the strong contradictory interactions.

Conclusion

This chapter provided a description of the participants in the study and the design of the TTPD Program. Each section of the chapter analyzed quantitative and qualitative data to answer the research questions. Data from the first research question revealed that, although the Tech Teachers reported an increase in their knowledge of technology integration-related topics such as the ISTE standards and the SAMR model through the TTPD Program, they remained divided in their beliefs about how technology is best achieved in practice. The second research question

showed a need for more organizational support in two of the five areas questioned (support for pushing into the classroom and provision of time to collaborate with classroom teachers). The Tech Teachers' PD meeting discussions also revealed a need for higher-level, system-wide administrative support and support from classroom teacher colleagues. Finally, the third research question's self-reported quantitative data indicated that the Tech Teachers' were confident in their abilities to fulfill TIS responsibilities, even though there was very little evidence gathered through qualitative methods to support their claim. The last research question was addressed with an activity systems analysis of the first two activity systems, using connections with the qualitative and quantitative data from the study to show complementary and contradictory intersystem interactions. All of the data collected and analyzed in this chapter will serve as the foundation for connections to research and frameworks from Chapter 2, implications for future PD and decision making in Newton District 57, and suggestions for future studies.

CHAPTER 5: DISCUSSION OF FINDINGS

Introduction

This chapter begins with a general discussion of the research findings framed around critical insights gained from the study. A re-examination of the significance of the study is followed by implications for practice and recommendations to the field of educational technology. Finally, suggestions for future research precede the chapter's concluding statement of the meaning of this study to the researcher.

Critical Insights Gained from Study

This study had the simple objective of using levels 2-4 of Guskey's (2000) Five Critical Levels of Professional Development Evaluation to examine the effectiveness of a non-traditional PD program offered to Technology Teachers. According to Guskey, those levels of evaluation include:

- Level 2 - Participants' Learning
- Level 3 - Organization Support and Change
- Level 4 - Participants' Use of New Knowledge and Skills

Due to a postponement in implementation of the TIS program, the study was unable to address any concrete findings in terms of level 4. The research findings did reveal critical insights about the TTPD Program relating to Guskey's Levels 2 and 3 of PD evaluation. First, the Tech

Teachers' learning showed both positive and neutral outcomes when considering both *knowledge* and *beliefs*, respectively. That is, their *knowledge* increased over the course of the program, however their *beliefs* were not significantly affected. Secondly, the Tech Teachers' perceptions of organizational support were unexpected. The following sections go into more detail about these two critical insights.

Participants' Learning

Guskey's (2000) second level of evaluation seeks to uncover the effect of the professional development on the participants' learning. This study revealed an increase in the participants' *knowledge* in every topic covered in the TTPD Program. The content of the TTPD Program was purposefully designed to include standards and theories rather than having a technocentric focus that would become quickly outdated (Mishra & Koehler, 2003). While the TTPD Program used technology for several interactive activities, it did not include instruction on any specific tools. By designing the TTPD Program curriculum around standards and theories rather than a checklist of skills (Mishra & Koehler), the program content offered a new focus different from the traditional technology PD that research has revealed as ineffective (Brinkerhoff, 2006; Matzen & Edmunds, 2007; Plair, 2008). In the end, the TTPD Program had a positive impact on the participants' learning. Considering the audience was a group of teachers who instruct children in the use of various technology skills, it was an accomplishment worth noting that the program added to their *knowledge* base in areas that affect their daily practice. The evidence of the Tech Teachers' increase in *knowledge* also supports the Speak Up 2013 National Findings (Project Tomorrow) showing that even advanced users of technology have a

wish list for professional learning. For example, the Tech Teachers in this study particularly wanted to know more about the SAMR Model, and the data showed that desire was fulfilled. The Tech Teachers also expressed a curiosity to learn more about the ISTE Profiles for Technology Literate Students during the session in which they were presented. While the Profiles were not a heavy focus of the TTPD Program, the Tech Teachers showed the second-greatest growth in their knowledge about the profiles. Many of the Tech Teachers possess a degree or endorsement in the area of educational technology but were still able to increase their knowledge though the TTPD Program centered on standards and theories of technology learning.

According to Guskey, participants' learning is more than just a change in *knowledge*. Part of the participants' learning also included their *beliefs* (Guskey, 2000). The data indicated the participants still held some *beliefs* about traditional PD designs as an effective means of supporting technology integration. In the sessions about technology PD design, one of the learning objectives was that participants would know basic principles of effective technology PD design to promote technology integration. It was a positive sign that the Tech Teachers rated their own jobs (i.e., providing technology skill-based lessons in isolation of the curriculum) as an ineffective way to promote technology integration. They essentially recognized their duties as misaligned with effective technology integration best practice. There were other indicators, however, that the Tech Teachers' beliefs about effective technology integration worsened over the course of the TTPD Program. The Tech Teachers' ranking of "Brief sessions that focus on one tool at a time and give teachers hands-on time to practice," for example, gained favor between the pre- and post-survey. This method of technocentric direct instruction is the epitome of PD that becomes quickly outdated (Mishra & Koehler, 2003) because of its narrow focus. The Tech Teachers also failed to acknowledge effective collaborative learning efforts such as

modeling and observing integrated lessons (Bradburn, 2004; Owens, 2009), ranking that option in the bottom half of their choices in both the pre- and post-survey. The Tech Teachers' beliefs about effective technology PD were not in alignment with the desired learning outcomes of the TTPD Program. A more explicit exploration of research on best practice for technology related PD is an area that should be emphasized in follow-up opportunities with the Tech Teachers, including an examination of specific examples and non-examples of well-designed PD. The recommendations section of this chapter will address this need in more detail.

Summary and Connections

Teachers' attitudes and beliefs, knowledge and skills were cited by many researchers as barriers to technology integration (Ertmer, 1999; Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Hew & Brush, 2007; Overbaugh & Lu, 2008; Overbaugh & Lu, 2009; Park & Ertmer, 2007). The TTPD Program attempted to address the knowledge and beliefs of the Tech Teachers who participated through a curriculum and delivery format that was informed by past research which found traditional technology PD to be technocentric in nature and generally ineffective (Brinkerhoff, 2006; Cuban, 2001; Harris et al., 2010; Mishra & Koehler, 2003). By focusing on standards and theories and extending the TTPD Program over time, the content and design flaws of traditional technology PD were avoided. Even though the data did not indicate a change in the Tech Teachers' beliefs about effective PD practices, the increase in participants' knowledge suggests that the TTPD Program was effective in terms of affecting participants' learning.

Perceptions of Support

As mentioned earlier, the district was not able to transition to the TIS program as intended, but the learning outcomes (i.e., building the Tech Teachers knowledge and skills in the areas of technology standards, the SAMR Model, Adult Learning Theory, etc.) could still be applied to the work of the Tech Teachers. The TTPD Program's focus on theories and standards rather than specific tools heightened the participants' awareness of the mismatch between what a TIS program would provide and what our district valued. This was clearly articulated in the data surrounding their perception of support at various organization levels.

As was found from Guskey's (2000) work, organizational factors can make or break the success of a PD program in a school or district. The careful evaluation of perceptions of support at all levels can provide invaluable understanding to help districts move forward successfully with change (Guskey, 2000). For this study, the pre- and post-survey questions only asked about perceptions of support from Tech Teacher colleagues, building administrators, and the TTPD Program administrators. However, the qualitative data revealed additional insights about the Tech Teachers' perceptions of support from other colleagues and administrators such as classroom teachers and central office administrators. The following sections provide details on the Tech Teachers' perceptions of support as revealed through the pre- and post-surveys as well as meeting discussions.

Surveyed Perceptions

The Tech Teachers' perception of support provided by the TTPD providers aligned closely with their consistent perception of high levels of collegial support from other Tech Teachers. As a job-alike group, they found each other to be supportive. The Tech Teachers also found the administrators directly involved in the facilitation of the TTPD Program (i.e. the Technology Coordinator and myself) to be supportive. Conversely, the lack of a push-in model and time, in general, for Tech Teachers to work with classroom teachers were indicators of unsupportive administrators at the building level. This lack of support revealed the need for clearer communication about the TIS roles and responsibilities, should that program ever be implemented. Additional perceptions of support that surfaced in some of the Tech Teacher meetings suggested that administrators and classroom teachers alike would need to understand the TIS role in supporting technology integration efforts. Even though the pre- and post-surveys did not explicitly ask about district administration or classroom teachers' support, it is important to examine the Tech Teachers' perceptions as part of the organizational support at all levels that is necessary for successful change efforts.

Additional Perceptions

Classroom teachers and district administration (i.e., the Superintendent, the Assistant Superintendent for Educational Services, the Director of Curriculum and Instruction) were two other groups of educators specifically identified by the Tech Teachers as not supporting technology integration. During multiple meetings it was suggested that the classroom teachers

did not value the Tech Teachers. For instance, the Tech Teachers specifically used the phrase "classroom teachers 'de-value' our position." The Tech Teachers also cited a lack of respect as facilitators of PD. Whether it is due to contractual language (i.e. technology class covers one of the classroom teachers' 30-minute preparation periods), building leadership, or personal relationships, the perception of disrespect was a major obstacle to successful implementation of the TIS program in this study. If classroom teachers are expected to participate in a coaching and collaborative professional relationship with TISs to help increase confidence and effectiveness (Beglau, et al., 2011), classroom teachers will need clear and compelling communication from the district and building levels about the importance of the TIS role. The Tech Teachers (or future TIS) will also need to do their part in demonstrating the value of their position and the benefits of effective technology integration for teachers and students. By beginning to build relationships with staff in their buildings, and working with teachers who are open to coaching, the Tech Teachers can set the foundation for successful implementation at a later time. For example, when the classroom teachers have a more clear understanding of the service the Tech Teachers can provide, and they have a trusting relationship, they can begin to collaborate on meaningful technology integration in manageable steps.

Additionally, the absence of a district vision or overt support for technology integration practices implies a great amount of work to be done in planning the implementation of a TIS program. The district's focus on investing in hardware without providing adequate training is not satisfactory. The Tech Teachers want guidance and support in creating a culture that values technology integration. Including Tech Teacher representation on the collaborative creation of a vision statement, to be discussed in the recommendations section, could help to ensure the

inclusion of curricular and professional learning considerations directly related to technology integration.

Summary and Connections

This study revealed mixed perceptions regarding organizational support for technology integration. The Tech Teachers felt supported by one another and by the TTPD administrators, but they did not feel supported by other groups. In particular, the Tech Teachers' assertions that the central office administration did not have a vision for technology integration is tantamount to ignoring technology use rather than embracing its potential to enhance teaching and learning practices and restructure the educational process (Halverson & Smith, 2009-2010; Johnson 2010). Newton District 57's investment in technology equipment and infrastructure was not enough to change practices toward technology integration the way that a well-articulated vision statement and integration plan could. The lack of organizational support as a barrier to technology integration has been cited by various researchers (Ertmer, 1999; Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Hew & Brush, 2007; Park & Ertmer, 2007) and was an obvious factor in the effectiveness of the TTPD Program.

Frameworks

Two frameworks were chosen as lenses for this research. First, levels 2-4 of Guskey's (2000) Five Critical Levels of Professional Development Evaluation were used to examine the effects of the TTPD Program on the participants. The study also intended to make use of

Yamagata-Lynch's (2010) Activity Systems Analysis to analyze the before, during, and after TTPD activity systems.

Guskey's (2000) Levels of Evaluation

The study used Guskey's (2000) levels 2-4 to examine the effects of the TTPD Program, but was only able to identify critical insights with regard to levels 2 and 3, as explained earlier. One of the critical insights from the study was related to participants' learning. However, the insights about the Tech Teachers' learning were clearly divisible into two separate concepts – *knowledge* and *beliefs* – as discussed in the previous section. Guskey's second level of evaluation is multi-faceted and made the data collection regarding participants' learning difficult. More specifically, examining the TTPD Programs effects on the participants' learning required two sets of questions. The first set of questions was specific to change in knowledge, and the second set addressed beliefs about technology integration. I was challenged in the data analysis chapter to explain that there were essentially two different outcomes regarding the participants' learning. The average reader who was not well versed in Guskey's levels could be easily confused by the seemingly contradictory effects on participants' knowledge and beliefs when they are both considered *learning*. For example, seeing that the Tech Teachers' knowledge increased in contrast to their beliefs remaining relatively neutral might suggest to some readers that true learning did not occur. Knowing that Guskey's level two incorporates multiple facets of learning is critical to understanding how the pre- and post-survey questions were framed and how learning was evaluated. Guskey's level three is more easily understood, even though it is also multi-faceted.

Guskey's third level of evaluation, participants' perceptions of organizational support, also provided one of the critical insights in this study. It was a challenge to narrow the nine areas of support into a manageable set of pre- and post-survey questions. Even though the survey questions were only intended to address 5 of the 9 areas of organizational support (Guskey, 2000), other perceptions surfaced in meetings and discussion-board contributions. For instance, the meetings and discussion boards allowed a more open forum for the Tech Teachers to express their perceptions of support from other colleagues and administrators. It is fortunate that the study included both quantitative and qualitative data, otherwise the additional perceptions may not have been exposed. The additional data about the Tech Teachers' perceived lack of support from classroom teachers and central office administrators will be extremely useful for TIS implementation plans in the future.

Ultimately, each of Guskey's (2000) levels has an intended purpose for the information gathered. Data collected in level two may be used to improve program delivery and design. Level three provides data to document and improve organizational support and/or to improve future change efforts. Data from level four could have served to monitor or judge the effectiveness of implementation, had the TIS program been put into place. The data collected in this study can be used for Guskey's intended purposes at levels two and three, but falls short of what was hoped for in this research.

Additionally, Guskey's (2000) levels do not align well with the current Standards for Professional Learning (Learning Forward, 2011). The professional development research on which Guskey based his levels focused on the content, context, and process of learning. While the new standards have these concepts embedded in them, they are far more comprehensive than past iterations. It would be extremely beneficial to the field of professional learning if Guskey

revised his levels of evaluation to reflect the 2011 Standards for Professional Learning. For example, he might consider organizing evaluation of professional learning in terms of planning as one level that would encompass the standards of "Data," "Resources," and "Learning Designs." Another level might focus on implementation, including the "Learning Communities," "Leadership," and "Implementation" standards. Finally, the last standard, "Outcomes," could be an additional level of evaluation, extending Guskey's level five to include educator performance outcomes as well. Figure 11 provides a high-level visual representation of how the standards and Guskey's levels might be combined for a "hybrid PD evaluation tool." The details of each level would have to be carefully authored to maintain the integrity of both the standards and Guskey's Levels.

Activity Systems Analysis

Although the use of Activity Systems Analysis was limited in this study due to the postponement of the change in the implementation of the TIS role in the district, the framework still had merit in analyzing the first two systems. If the district were to move forward with the TIS plan, I still believe that Activity Systems Analysis would provide a unique perspective on the progress of implementation that could not be captured thoroughly through the use of typical feedback surveys. Professional learning at its best is a collaborative process for which Activity Systems Analysis can complement quantitative data to provide a "human" perspective.

Figure 11: Hybrid PD evaluation tool

Significance of the Study

The intention of this study to add to the field of research regarding technology integration was achieved by examining a PD program designed to lay the foundation for transitioning to a TIS system, a perspective that had not been researched by others. Using case study research and activity systems analysis, has been done in other studies to examine classroom teacher adoption of technology integration practices (Blin & Munro, 2007; Russell & Schneiderheinze, 2005). These studies, like mine, found contradictions in activity systems that affected the object/outcome. These contradictions included barriers to technology use such as those established by Ertmer (1999) and an apparent mismatch in administrative and teacher vision for technology integration. Activity systems analysis, in particular, has been used in the fields of education, human development, human computer interaction, and others as a means to understand development and change (Allen, Karanasios & Slavova, 2011). It is for this reason that the use of activity systems analysis in my research was successful in identifying contradictions that led to the temporary abandonment of the TIS system implementation. My familiar methodology coupled with my unique focus on the TTPD Program evaluation as a vehicle for TIS readiness was truly an innovative contribution to the field.

Recommendations

The TTPD Program was designed from the very beginning to be just one step in a larger TIS implementation plan that, unfortunately, never came to fruition. The critical insights gained from this study, however, will inform plans and decisions as the TIS program may be considered

for future implementation. The perceptions of organizational support are a potential barrier to technology integration that must be addressed to move forward. An effective PD program that was designed for Tech Teachers and could be adapted for classroom teachers, such as the TTPD Program from this study, will also increase the chances for a successful TIS implementation. This study's critical insights can serve as an example for other districts considering a TIS program, or for technology PD designers hoping to break through some of the barriers to integration.

District Recommendations

For districts that are considering implementing a TIS program to promote effective technology integration practices, the results of this study lead to three major recommendations: 1) the creation of a vision statement; 2) an examination of district climate; and 3) implementing a public relations campaign and a pilot of the program on a smaller scale.

Vision Statement

The lack of a vision regarding technology, both at central office and at the building level, stood out in the research data. This suggests that districts interested in implementing a TIS program should include the collaborative creation of a vision for technology and the clear communication of that vision to all stakeholders. The district should consider inviting classroom teachers, Tech Teachers, building and central office administrators, and union representatives to author the vision statement. A protocol for designing vision statements and the use of a tuning protocol for refining and wordsmithing would be particularly useful for the stakeholder group to

stay focused and productive. A tuning protocol is a structured activity in which the group can examine the content of the vision statement to make sure it is "in tune" with the original intentions.

The shift from providing technology skills to students to infusing technology in their everyday interactions with the curriculum must have a professional climate conducive to such a change. As with any change in education, the context in which the change is more likely to succeed is one where educators feel valued personally and professionally. Including all stakeholders' voices in the creation of a vision statement is one way to show district-wide organizational support. The subsequent communication of this vision with the support of all parties involved in its creation may provide for greater acceptance of the transition to a TIS program. The team who created the vision statement should be responsible for sharing it with all staff, preferably in a forum where all-staff attendance is required. The presenters should convey confidence in their work so the presentation serves as a "kick-off" to creating a culture that values technology integration. Ideally, the visionary team would continue to work on developing implementation plans that align with the vision and sharing those plans through building meetings, newsletters, a guidebook, etc.

District Climate

In addition to recommending the creation and communication of a vision statement, I feel compelled to include in this section some cautionary wisdom about the influence of the teachers' union in the progress (actually the impediment) of our district's transition to a TIS program. In a year of contentious contract negotiations, the union and even individual teachers made innovation seem like a dirty word, an idea that involved too much effort for already overworked teachers. This aspect of our climate was a critical factor in the district's inability to transition to

the TIS program. For this reason, I recommend an honest examination of the district climate be taken into consideration prior to work on a vision statement. This honest examination may include meetings between union leadership and the district administrative team. It may also include exploration of the collective bargaining agreement to prevent potential violations of teachers' rights. Lastly, the district administration can get a good idea of the climate by simply visiting buildings on a regular basis to establish trust and show interest in the working conditions of teachers. The creation of a vision statement and a candid examination of the climate and culture in the school buildings, could help the district administration establish (or rebuild) a relationship between administrators and teachers that values the risk-taking and innovation involved in technology integration.

Program Promotion and Pilot

One last recommendation is to promote an understanding and appreciation for the TIS position and its critical service to all staff. In various stages of the TTPD Program, the Tech Teachers themselves expressed that they felt undervalued either by their administrators or their classroom teacher colleagues. Without a clear understanding of the TIS responsibilities, administrators and teaching staff may view the TIS no differently than an IT support person. Understanding the TIS responsibilities, however, is not sufficient to appreciate the TIS contribution to professional growth and student learning. I recommend an official public relations campaign to promote the TIS position as one that is beneficial to all as collaborative, job-embedded professional learning. The district may consider running a pilot of the TIS program in schools whose leadership teams have already shown an appreciation for technology

integration, but may need extra support. Participants in the pilot could provide anecdotal feedback about their experiences. This feedback could be used to make improvements to the program and also to "spread the word" via informational flyers or promotional videos.

Technology PD Recommendations

The TTPD Program had mixed results in terms of the participants' learning. Their *knowledge* increased over the course of the program, but their beliefs about effective technology PD were neutral to negative. It is my recommendation that other designers of technology PD consider adding more explicit coverage of effective technology PD to the content of the TTPD Program. Participants in the TTPD Program left with varied ideas of how to best share technology integration knowledge and skills with their colleagues. For example, the PD may include a session or sessions focused on examining research about effective technology PD. The PD facilitator could use any number of protocols to encourage discussion about the readings as well as ideas for application of research-based best practices within the scope of the TIS position. Another consideration in this area is the inclusion of unified theory of acceptance and use of technology (UTAUT) in the TTPD curriculum. This theory "has been widely employed in technology adoption and diffusion research" and would help the Tech Teachers understand the core constructs that influence technology adoption (Williams, Rana & Dwivedi, 2014). Knowledge of UTAUT combined with adult learning theory could help the Tech Teachers build a stronger understanding of how to meet the needs of their classroom teacher colleagues. If the TIS candidates are included as designers of their own professional responsibilities, it may inspire them to include duties that were not considered by a Human Resources administrator writing a

job description. As a core responsibility of the TIS position, it is critical that the participants of a TIS training program leave with not only a knowledge of best practice, but also a comfort in application of such techniques.

Another recommendation is that PD related to the TIS program include ongoing training in addition to the initial TTPD. Due to the halt in implementing the TIS program in Newton District 57, the future TIS candidates were not able to continue their learning or practice the application of the TTPD knowledge. As with any effective professional development design, sustained learning over time will produce the best results.

Suggestions for Future Research

This section includes suggestions for future research based on the strengths and weaknesses of this study. It would not be feasible, or advisable, for any single future study to undertake all of the recommended changes. For this reason, Table 12 organizes the suggestions by theme to aid future researchers in selecting a focus to this research.

The complexity of these suggestions for future research offers the potential to provide critical contributions to the field of technology integration. Future researchers who take on even one of the suggestions listed above will undoubtedly gain additional insight into factors that could influence the successful implementation of a TIS program.

Table 12

Thematic Organization of Suggestions for Future Research

Theme	Suggestion
Research Design	• Make use of the Activity Systems Analysis framework for the transition to the TIS program model. • Continue with a mixed methodology for data collection to ensure rich data from a variety of sources.
PD Design	• Design the TTPD program as an ongoing PD series, with reserved time for PD throughout the planning and implementation phases. • Add explicit instruction on best practices for technology PD to the TTPD Program curriculum. • Create a side-by-side learning experience for classroom teachers or administrators to learn theory and standards *with* the TIS candidates.
Data Collection	• Build in dedicated time for the completion of pre- and post-surveys to encourage greater participation and thorough contributions. • Observe the case study participants before the TTPD program; work with them to develop a focus for the future observations based on the TTPD learning objectives; and observe again at various other times during the TTPD Program and beyond. This will provide more longitudinal data to show growth with multiple data points. • Create a hybrid PD evaluation tool that combines Guskey's (2000) levels of evaluation and criteria that clearly align with the 2011 Standards for Professional Learning. • If the TIS program is implemented, collect qualitative and quantitative data from various stakeholder groups over time to evaluate the TIS program's impact on student learning (TIS, classroom teachers, administrators, and students).

Conclusion

It was my intention when this study began to develop and deliver a TTPD Program that would set up the TIS program for success. I accomplished this goal, but only in part. Because the TIS program implementation was postponed indefinitely due to the district climate, the effects of the TTPD program were limited to the Tech Teacher's knowledge and beliefs. It was difficult to accept the unexpected truncation of my work, but I take heart in the possibility that future researchers will be able to expand upon my work and truly evaluate the impact of such a program.

After a longer-than-expected portion of my life has been dedicated to the conception and execution of this research, I can honestly state that I am pleased with the contribution my study can provide to the field of educational technology. Having served as a TIS myself with no formal training, I always had a gut feeling that I was "doing it right." My research has validated my former work as a TIS and helped me grow in my current role as a designer of professional learning.

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APPENDIX A

PRE- POST-SURVEY INSTRUMENT

Technology Teacher Professional Development
Spring 2015 – Pre/Post Survey

(administered confidentially through www.surveymonkey.com)

Section 1: PD Curriculum Knowledge

Please rate your knowledge of the following topics according to the scale provided. Answers of 3, 4, or 5 require brief details.

1 – No knowledge	**2 – Basic working knowledge**	**3 - Basic knowledge and some application**	**4 – Advanced knowledge and some application**	**5 – Advanced knowledge and application**
1. ISTE Standards•S				
Details:				
2. ISTE Profiles for Technology Literate Students				
Details:				
3. ISTE Standards•T				
Details:				
4. ISTE Standards Implementation Wiki				
Details:				
5. Learning Activity Types (Harris and Hofer)				
Details:				
6. SAMR continuum of technology integration				
Details:				
7. Adult Learning Theory				
Details:				
8. Instructional Design for Technology PD				
Details:				

Section 2: Technology Integration Beliefs

Please rank your belief standpoint on the following statements. (Rank the statement you agree with most as #1)

I believe that technology integration is best accomplished through…

1. Conferences or workshops that provide a wealth of suggested applications for teachers to use in their classrooms
2. Brief sessions that focus on one tool at a time and give teachers hands-on time to practice
3. Ongoing sessions that build teachers' confidence with technology over time by providing not only hands-on time to practice but also follow up support for trouble shooting or other needs
4. Observations of model lessons that incorporate technology into content-based lessons addressing the content standards
5. Co-planning and/or co-teaching with a technology specialist to integrate technology into a content-based lesson addressing the content standards
6. A technology specialist delivering a skills-based curriculum in isolation of content or curricular standards

Section 3: Organization support

Please rate your belief standpoint on the following statements.

1 – Strongly disagree	**2 – Disagree**	**3 - Neither agree nor disagree**	**4 – Agree**	**5 – Strongly agree**

I feel…

1. That I have the necessary knowledge and skills to provide personalized Instructional Technology support to teachers.
2. That I have the support of my building administrator to protect my schedule from inclusion of duties that are unrelated to Instructional Technology support.
3. That I have the support of my building administrator to push-in to the classroom without being asked for confidential information about a teacher's performance.
4. That I can depend on my colleagues from this program to continue a professional learning network in which we share ideas, lessons, etc. to help all teachers in all buildings.
5. That I can depend on the Curriculum Technology Facilitator or Professional Development Coordinator to continue to build upon and refine my skillset as a Technology Integration Specialist.
6. I will have adequate time to work with the staff in my assigned building(s) over the course of the year to develop both teacher and student proficiencies with Instructional Technology.

Section 4: ISTE Standards•C

Please rate yourself on the following statements.

1 – Strongly disagree	2 – Disagree	3 - Neither agree nor disagree	4 – Agree	5 – Strongly agree

I believe I can assist classroom teachers in…

1. Facilitating and inspiring student learning and creativity.
2. Designing and developing digital age learning experiences and assessments.
3. Modeling digital age work and learning.
4. Promoting and modeling digital citizenship and responsibility.
5. Engaging in professional growth and leadership regarding technology integration.
6. Using technology effectively for assessing student learning, differentiating instruction, and providing rigorous, relevant, and engaging learning experiences for all students.

I believe that I personally…

1. Have the visionary leadership to participate in the development and implementation of a shared vision for the comprehensive integration of technology to promote excellence and support transformational change throughout the instructional environment.
2. Can create and support effective digital age learning environments to maximize the learning of all students.
3. Can conduct needs assessments, develop technology-related professional learning programs, and evaluate the impact on instructional practice and student learning.
4. Can effectively model and promote digital citizenship.
5. Can demonstrate professional knowledge, skills, and dispositions in content, pedagogical, and technological areas as well as adult learning and leadership.
6. Am continuously deepening my knowledge and expertise in the area of educational technology.

APPENDIX B

NOTE TAKING TEMPLATE

Meeting Notes Template

Meeting ____ of ____			
[Pick the date]	Time: 7:45 – 8:30	Location: _____ Elementary	
Type of meeting	PLC		
Facilitator			
Note taker			
Attendees			
Agenda Topic:			
Time allotted:	Presented by:		
Discussion			
Action Items		Person	Deadline
Initial reactions to relevance for research questions			
Research Question 1: knowledge and beliefs about technology integration (Guskey Level 2)			
Tech Teacher			
Tech Teacher			
Initial reactions to relevance for research questions			
Research Question 2: organizational change and support (Guskey Level 3)			
Tech Teacher			
Tech Teacher			
Initial reactions to relevance for research questions			
Research Question 3: TIS abilities (Guskey Level 4 – modified)			
Tech Teacher			
Tech Teacher			

APPENDIX C

ISTE·C, ISTE·S, ISTE·T STANDARDS

ISTE·C Standards (from: https://www.iste.org/standards/standards/standards-for-coaches)

1. Visionary leadership
2. Teaching, learning, and assessments
3. Digital age learning environments
4. Professional development and program evaluation
5. Digital citizenship
6. Content knowledge and professional growth

ISTE·S Standards (from: https://www.iste.org/docs/pdfs/20-14_ISTE_Standards-S_PDF.pdf)

1. Creativity and innovation
2. Communication and collaboration
3. Research and information fluency
4. Critical thinking, problem solving, and decision making
5. Digital citizenship
6. Technology operations and concepts

ISTE·T Standards (from: https://www.iste.org/docs/pdfs/20-14_ISTE_Standards-T_PDF.pdf)

1. Facilitate and inspire student learning and creativity
2. Design and develop digital age learning experiences and assessments
3. Model digital age work and learning
4. Promote and model digital citizenship and responsibility
5. Engage in professional growth and leadership