TYPES OF PROFESSIONAL DEVELOPMENT AND PRINCIPAL LEADERSHIP ACTIONS FOR INSTRUCTIONAL TECHNOLOGY INTEGRATION IN THE MIDDLE SCHOOL ONE-TO-ONE CLASSROOM

A Doctoral Research Project
Presented to
Associate Professor Dr. Francesca Durand
Doctoral Committee Chair
Esteves School of Education
The Sage Colleges

In Partial Fulfillment of the
Requirements for the
Degree of Doctor of Education
In Educational Leadership

David M. Casamento

May 5, 2017

TYPES OF PROFESSIONAL DEVELOPMENT AND

PRINCIPAL LEADERSHIP ACTIONS

FOR INSTRUCTIONAL TECHNOLOGY

INTEGRATION IN THE MIDDLE SCHOOL

ONE-TO-ONE CLASSROOM

We represent to Sage Graduate School that this thesis/dissertation and abstract are the original work of the author(s) and do not infringe on the copyright or other rights of others.

June 14, 2017

David Casamento — Date of Signature

June 14, 2017

Francesca Durand, PhD — Date of Signature

Associate Professor of Education

Doctoral Research Committee Chair

ACKNOWLEDGEMENTS

This dissertation would not have been possible without the support of my family, friends, colleagues, and professors.

I would like to begin by thanking the professors who helped me and guided me through the dissertation process. In particular, I would like to thank Dr. Salvatore DeAngelo for being the third reader on my committee. I would also like to thank Dr. Deborah Shea who supported my writing and provided invaluable recommendations to make me a better writer. Similarly, I would like to thank Dr. Joseph Dragone who provided constant support and encouragement for Chapters 3-5 and who I value as a trusted friend, colleague, and mentor. Finally, I would like to thank my dissertation chairperson, Dr. Francesca Durand who never wavered in her support and encouragement throughout the process. She made herself available to me at a moment's notice and provided reassurance when I doubted myself.

There are three friends who provided endless support throughout this journey. My friend Dr. Danielle Gately encouraged me to begin this journey and she stayed with me throughout the entire process. Second, I thank my friend Mike Bucko who listened to me nightly while I talked about my progress and worries. Although unfamiliar with the process he just listened and let me vent. Third, I'd like to thank all of Cohort IX, but especially Ebony Green. Ebony was there for me when I was stuck, upset, happy, and ecstatic. She never let me take myself too seriously.

Finally, words cannot express my deepest appreciation to my husband, Andrew Berends. Without his steadfast support, patience, and encouragement, I could have never completed this dissertation. He sacrificed so much with me for the last two years. I love you and appreciate you for everything you are. This accomplishment, is our accomplishment. Thank you!

ABSTRACT

TYPES OF PROFESSIONAL DEVELOPMENT AND PRINCIPAL LEADERSHIP ACTIONS FOR INSTRUCTIONAL TECHNOLOGY INTEGRATION IN THE MIDDLE SCHOOL ONE-TO-ONE CLASSROOM

David M. Casamento,
The Sage Colleges, Esteves School of Education, 2016

Dissertation Chair: Dr. Francesca Durand

Over the past ten years, districts have made large purchases of instructional technology for use in the classroom. In particular, many districts are purchasing one device per one student, otherwise known as one-to-one initiatives (Dorfman, 2016). The costs of these initiatives are great and because of this, communities are demanding they be integrated into the curriculum (Dunleavy, Dexter, & Heinecke, 2007; Hayes & Greaves, 2013).

There are multiple barriers to successful integration of instructional technology (Ertmer, 1999). To overcome these barriers and beliefs, teachers need professional development in a variety of forms: formal, informal, and independent (Jones & Dexter, 2014). Additionally, educational leaders, particularly principals, need to take an active role through their leadership actions in

making certain teachers receive the professional development they need as well as to support technology integration actions in the classroom (Chang, 2012).

The purpose of this study is to examine the relationship between formal, informal, and independent instructional technology professional development offerings, the leadership actions of Principals and teacher biases and barriers, and their influence on public middle school teachers' integration of instructional technology in a one-to-one environment.

This quantitative study utilized cluster sampling of 12 Long Island, New York middle schools with at least one grade having an established one-to-one initiative. From these schools and grades, 1040 teachers were surveyed concerning the leadership actions of their principals in relation to professional development and instructional technology integration, teachers' beliefs about, and barriers to, instructional technology integration, and how they integrated instructional technology after participating in each of the three forms of professional development.

The findings from this research indicate that principals need to take a more active role, through their actions, to both encourage teacher participation in formal, informal, and independent professional development, and promote instructional technology integration. Letting teachers know they will be evaluated on instructional technology integration was found to be effective for integration. Additionally, teachers continue to use formal professional development to help them integrate instructional technology more than informal and independent professional development. Finally, teachers continue to report time as a belief and barrier to instructional technology integration far more than any other barrier in these one-to-one classrooms.

Keywords: Professional Development, Instructional Technology, Digital Leadership, Technology Integration, Technology Leadership

Table of Contents

List of Tables

List of Figures

Chapter 1:
Introduction

Background/Overview

Over the last ten years, many schools have invested in one-to-one computing initiatives for which each student is provided their own personal computing device to be used in all subjects (Dorfman, 2016). Other names for one-to-one-computing include one-to-one environments or one-to-one classrooms. There are several reasons given for implementing these initiatives, including allowing students access to information at all times, expectations for increased student learning, teaching students how to use digital tools, collaboration, and differentiation of instruction (Downes & Bishop, 2015; Lei & Zhao, 2008; Russell, Bebell, & Higgins, 2004; Swan, Kratcoski, Mazzer, & Schenker, 2005). Additionally, investing in one-to-one computing comes with calls for accountability in terms of student achievement and integration of the devices into the curriculum (Dunleavy et al., 2007).

The key to the success of these initiatives depends on the teacher's level of instructional technology integration in the classroom (Penuel, 2006). A teacher's beliefs about students' academic success, teaching, and the role of computers in the classroom have been shown to have a correlation to the success or failure of technology implementation (Lumpe & Chambers, 2001). These beliefs are sometimes held and affirmed by the culture of the school in which the teacher is situated and it has been found that teachers are more likely to integrate technology if they are in schools where this practice is prevalent among other teachers (Windschitl & Sahl, 2002).

There are also barriers that prevent teachers from integrating instructional technology in their classrooms (Ertmer, 1999; Levin & Wadmany, 2008). To name a few, these barriers include time, support, leadership, professional development, and money (Cuban, Kirkpatrick, &

Peck, 2001; Duhaney, 2001; Hew & Brush, 2007; Skues & Cunningham, 2013). Overcoming these barriers remains a struggle both here in the United States and abroad (Davidson, Richardson, & Jones, 2014). Removing these barriers requires leadership for professional development and leadership for instructional technology integration.

One-to-one environments require effective digital leadership from the building principal (Russell et al., 2004). Digital leadership actions include communicating the vision, encouraging and supporting teacher professional development, lowering barriers and changing beliefs about instructional technology, providing resources, modeling technology use, and providing support for curricular changes (Anderson, Dexter, Center for Research on Information Technology and Organizations CA., & Minnesota Univ., 2000; Chang, 2012). Digital leadership derives from both instructional and transformational leadership and speaks to a leader's role as a source of educational expertise (Barth, 1986). At the same time, digital leaders build teams that support one another for the purpose of accomplishing collective goals (Leithwood, 1994). As technology changes at a rapid pace, digital leaders need to manage change in order to install confidence and competence across the organization (Bridges, 2009; Kotter, 2012). Sheninger (2014) says this change is best managed by staying connected, creating the vision and articulating its value, participating in professional development, providing support, and removing barriers and changing beliefs.

The greatest actions a digital leader can provide for successful instructional technology integration are to remove barriers to integration, foster participation in professional development, change the beliefs of teachers about attending instructional technology professional development, and promote the value of instructional technology in the classroom (Hixon & Buckenmeyer, 2009; Lumpe & Chambers, 2001; Sheninger, 2014). Professional development is

needed to navigate the delicate dance that exists between technology, curriculum, and pedagogy (Mishra & Koehler, 2006; Sheumaker, Slate, & Onwuegbuzie, 2001).

Effective professional development for technology integration includes connecting the learning to student achievement, providing hands-on learning, providing a variety of experiences, changing teachers' beliefs and practices, allowing time for collaboration, mentoring and coaching, and making the professional development "just in time" (Hixon & Buckenmeyer, 2009; Jones & Dexter, 2014; Parr, 1999; Rodriguez & Knuth, 2000; Smolin & Lawless, 2011). Additionally, teacher professional development for technology integration should be focused in the areas of content, technology and pedagogy (Koehler & Mishra, 2009). Teachers who attend professional development are much more likely to try new methods of delivering instruction and integrating instructional technology than teachers who do not attend professional development (Scott & Mouza, 2007). Although professional development adds cost to one-to-one implementation, it is recommended that 25 to 30 percent of the monies for a one-to-one initiative be spent on professional development to ensure instructional technology integration (Twining, Raffaghelli, Albion, & Knezek, 2013).

Effective professional development can be delivered and/or attained in one of three forms: formal, informal, or independent professional development. Formal professional development, also known as traditional professional development consists of trainings that are often face to face, one-time experiences, held at a certain time, and aligned with district goals (Jones & Dexter, 2014; Lawless & Pellegrino, 2007).

Informal professional development describes interactions and discussions between teachers, with no specified instructor, at unspecified times during the school day (Jones & Dexter, 2014). The benefit to this form of professional development is that teacher learning is

"just in time," but the learning may not be aligned with district goals (Garet, Porter, Desimone, Birman, & Yoon, 2001; Hew & Hara, 2007).

Independent professional development is completely self-directed. Teachers who participate in this form of professional development are self-motivated, life-long learners (Dede, 2006; Trust, 2012). This form of professional learning utilizes emerging technologies such as Google, Pinterest, Twitter, and other web 2.0 tools (Jones & Dexter, 2014). Encouraging teacher professional development and technology integration requires strong digital leadership with a vision of how technology will be best integrated into schools and districts (Sheninger, 2014).

Statement of Problem

Each year, the number of schools with one-to-one computing initiatives increases. As of 2006, the number of North American students (USA, Canada, and Mexico) enrolled in one-to-one programs was about 500,000 and increasing at a rate of 15 percent annually (Vascellaro, 2006). In the 2013-14 school year, schools in the United States purchased over 23 million devices for classroom use (Herold, 2016). According to Futuresource Consulting, a U.K.-based research firm, more than half of U.S. students now have access to school-issued personal computing devices, and currently, the states of Utah and Nevada are considering state-wide one-to-one computing initiatives (Herold & Kazi, 2016). This increase has been made possible due to the decreasing cost and increasing public interest in such initiatives (Networking, 2004; Zucker & Light, 2009).

In 2013, Apple iPads controlled 94 percent of the one-to-one market, but due to the lower cost of other devices, Apple shipped 702,000 iPads compared to the 713,000 Chromebooks that were shipped for one-to-one initiatives (Molnar, 2014). The number of Chromebooks to iPads is

expected to increase even more because these devices are more shareable, make keyboarding tasks easier to perform, are easy to maintain, and are projected to cost less than 300 dollars in the future (Bolluyt, 2016; Molnar, 2014).

However, there are many hidden and not-so-hidden associated costs for one-to-one computing including device repair, device purchase and replacement, professional development, wireless network maintenance, and leadership training (O'Hanlon, 2007). In 2013, the reported costs of one-to-one initiatives ranged from 250 to 1000 dollars per student per year (Hayes & Greaves, 2013). Due to high costs and a lack of, or conflicting, data considering proven benefits, several districts have either reexamined, halted implementation, or partially or completely retreated from their one-to-one computing initiatives (LeMagie, 2010; Vascellaro, 2006). As an example, the Maine Learning Technology Initiative is now costing the state $11.5M per year to run. Because of this and the lack of evidence of the program's benefit to students, Governor Paul LePage is considering a range of options from scaling back the program to ending it outright (Herold & Kazi, 2016). Similarly, Michigan pulled funding for its program shortly after it was implemented and Texas and Pennsylvania's one-to-one initiatives were never fully implemented (Herold & Kazi, 2016). Breakages are another concern. In 2007, Broward County Schools spent more than $100,000 for screen and non-warranty covered damages (Hu, 2007). These issues have led many to call for a planned and systematic financial investment for one-to-one computing (Keengwe, Schnellert, & Mills, 2011).

Along with cost, one-to-one initiatives are also facing a lack of data supporting the efficacy of such programs. Due to this, many districts, both large and small, have decided to discontinue their one-to-one initiatives after only a short period of time (Hu, 2007). However, earlier this year, Zheng, Warschauer, Lin, and Chang (2016) performed a meta-analysis of 15

years of studies which showed an increase in academic achievement and a slight increase in attainment of 21st Century Learning skills. Additionally, in 2012, Keengwe and Schnellert found, "the integration of one-to-one laptop computing increased student engagement and learning, motivation, and ability to work individually" (p. 144). Even researchers who found no increase in student achievement believe that many districts may be ending their one-to-one initiatives before teachers are fully trained, barriers are removed, and digital leadership has been fully implemented (Hu, 2007).

This conflicting, or lack of data, about the benefits of one-to-one computing and the associated cost for these initiatives highlights the importance of identifying what, if anything, can be done to validate these programs with greater instructional technology integration. Currently, there is insufficient research concerning the interplay between teacher beliefs, instructional technology barriers, digital leadership, and professional development to support teachers in integrating instructional technology in the one-to-one classroom. Research on the importance of professional development for the integration of instructional technology integration is prevalent, yet lacking is an identification of the specific types of professional development that yield the greatest integration of technology in the one-to-one classroom (Garet et al., 2001; Hew & Hara, 2007; Scott & Mouza, 2007). There also remain questions in the literature about the actions principals can take to increase or decrease the teacher's willingness to participate in instructional technology professional development and integrate this learning in their one-to-one classrooms. Answers to these questions will aid school and district leaders to exercise their fiduciary roles responsibly.

Purpose Statement

The purpose of this study is to examine the relationship between formal, informal, and independent instructional technology professional development offerings, the leadership actions of principals and teacher biases and barriers, and their influence on public middle school teachers' integration of instructional technology in a one-to-one environment. This quantitative, correlational design study will be examined through analysis of survey results and the conceptual framework of Digital Leadership and the Technology, Pedagogy and Content Knowledge (TPACK) framework. The population for this study will be public middle school teachers of grades five through eight teaching in a one-to-one environment on Long Island, New York.

Research Questions/Hypothesis

1. Is there a relationship between the leadership actions of principals and teacher participation in instructional technology professional development?
2. Is there a relationship between professional development taken in instructional technology by teachers and the use of instructional technology integration in the middle school one-to-one classroom?
    a. Does participating in formal teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?
    b. Does participating in informal teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?
    c. Does participating in independent teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?

3. Is there a relationship between the leadership actions of principals and the integration of instructional technology in the one-to-one classroom?

4. What are the teacher biases and barriers toward instructional technology and the integration of instructional technology in the one-to-one classroom?

Theoretical/Conceptual Framework

This study will use two frameworks to develop the survey instrument and inform the literature review. One concerns the integration of instructional technology in the classroom and the second discusses digital leadership in the 21st Century.

Increasing the level of technology integration has been the source of numerous research studies (Ertmer, 2005; Levin & Wadmany, 2008; Machado & Chung, 2015; Pierce & Ball, 2009; Shuldman, 2004). The selected model describing instructional technology integration in this paper is the Technology, Pedagogy, and Content Knowledge (TPACK) framework (Mishra & Koehler, 2006). This model, attempts to look at technology integration as the interaction of three types of knowledge: content, pedagogy, and technology. The premise is that in order for successful technology integration, teachers need to make connections between all three forms of knowledge (Figure 1).

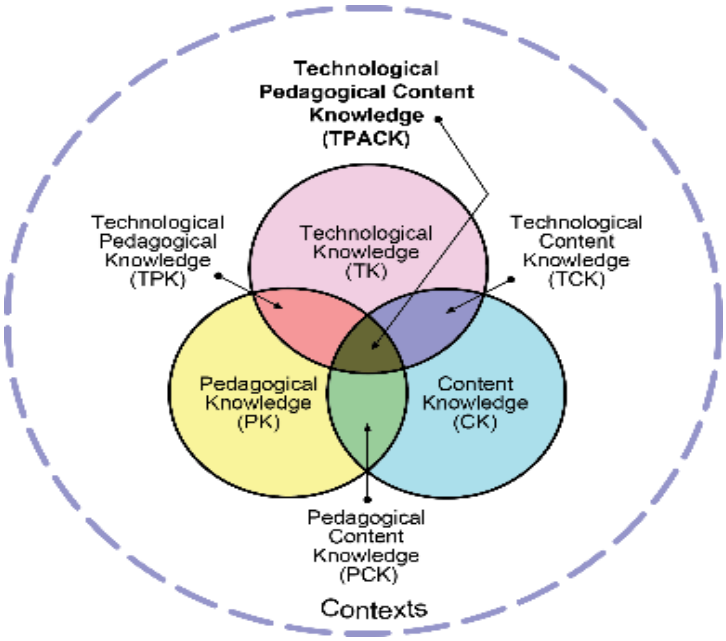

Figure 1. TPACK Framework

The TPACK model was developed from the work of Shulman (1986), who discussed the intricate connections teachers need to make between content knowledge and pedagogical knowledge while delivering instruction. Content knowledge (CK) is the "amount and organization of the content in the mind of the teacher" (Shulman, 1986, p. 9). In turn, pedagogy knowledge is, "deep knowledge about the processes and practices or methods of teaching and learning and how it encompasses, among other things, overall educational purposes, values, and aims" (Mishra & Koehler, 2006, p. 1027). Technology knowledge is the level of understanding and comfort a user has utilizing specific technologies (Koehler & Mishra, 2009).

The overlap between content and pedagogy knowledge is referred to as pedagogical content knowledge (PCK). This knowledge is how teachers assess what needs to be taught from the curriculum and employs best practices from lesson planning and preparation to deliver instruction (Mishra & Koehler, 2006; Shulman, 1987). The intersection between technology and

content knowledge is called technological content knowledge (TCK). This intersection describes how technology can be used to change the content in ways to make it more understandable for students and this in turn changes the organization of the content for the teacher (Mishra & Koehler, 2006). The more technologies the teacher knows, the more likely they are to be able to apply the technology to the content. The intersection between technology and pedagogy is called technological pedagogical knowledge (TPK). This pair describes how technology can be used to change pedagogy such that teachers deliver instruction in new and meaningful ways for student understanding (Mishra & Koehler, 2006).

The area in the center of the circle that is the intersection of technology, pedagogy and content is called technological, pedagogical, content knowledge (TPACK). This theory has been researched extensively by Koehler & Mishra (2009) and describes how technology is integrated best when teachers have a complete understanding of the interactions between technology, pedagogy, and content. This intersection is best attained through focused professional development (Koehler, Mishra, & Cain, 2013). The survey used in this research was developed with these different forms of knowledge and their intersections in mind. Analyzing the questions concerning the forms of professional development taken by teachers and their instructional technology integration after having taken each form will be viewed from the TPACK model of instructional technology integration.

The second framework utilized in this paper is digital leadership. Digital leadership involves creating optimal conditions for teachers to integrate instructional technology, and for schools and staff to meet the ever changing needs of all stakeholders in the school community (Sheninger, 2014). Digital leadership theory contains many of the same leadership actions as the existing literature on effective leadership (Afshari, Bakar, Luan, & Siraj, 2012; Chang, 2012;

Chang, Chin, & Hsu, 2008; S. L. Dexter, 2011; Leithwood, 1994). Creating a vision, modeling for teachers, providing support and resources, providing professional development, and reducing barriers and alleviating beliefs, are all actions of the digital leader as well as actions of the effective leader (Chang, 2012; Frank, Zhao, & Borman, 2004; Jones & Dexter, 2014).

Fullan's (2008) change theory was the forerunner to the development of the seven pillars of digital leadership: communication, public relations, branding, professional growth and development, student engagement and learning, opportunity, and learning environment and spaces (Sheninger, 2014). This research will examine the leadership actions of principals as they relate to professional growth and development and student engagement and learning through the integration of instructional technology. Chang, Chin, and Hsu (2008) state, "the principal's technology leadership proficiency is paramount to the current needs of public education" (p. 232).

The importance of digital leadership to both instructional technology integration as well as teacher professional development are addressed in this study. While developing the survey, specific questions were asked to ascertain teachers' perceptions about their leader's actions relative to their willingness to participate in professional development and the actions that their principals took/take to encourage them to integrate instructional technology after having taken each of the various forms of professional development. Thus, these survey questions will be analyzed through the digital leadership framework.

Significance of the Study

Over the past 30 years, districts around the world have been implementing one-to-one computing in a variety of forms and with a range of fidelity (Dunleavy et al., 2007). During this same time frame, research has been building about effective instructional technology integration,

and yet, few teachers are effectively integrating instructional technology in their classroom (Davidson et al., 2014). Additional research has been conducted about effective professional development, but most districts are approaching and delivering professional development in the same way they have for the past 30 years (Williams, Atkinson, Cate, & O'Hair, 2008).

Current literature in the area of instructional technology integration include articles on professional development for integration (Hixon & Buckenmeyer, 2009; Jones & Dexter, 2014), principal actions leading to increased integration (Chang, 2012), and teacher barriers and beliefs to integration (Ertmer, 1999, 2005). The existing gap in the literature that this study intends to address is how each of these factors apply to integrating instructional technology in the one-to-one classroom. One-to-one classrooms create unique learning opportunities for students while at the same time pose challenges for teachers who are asked, and sometimes required, to integrate these devices in their classrooms (Abell Foundation, 2008; Dunleavy et al., 2007).

This study is important in that it will help guide superintendents, curriculum directors, instructional technology directors, principals, and technology integration coaches in making cost effective decisions when implementing a one-to-one environment. Costs associated with one-to-one implementation include infrastructure, purchasing and replenishing equipment, maintaining equipment, and providing professional development (O'Hanlon, 2007). In terms of professional development, it would be wise for administrators at all levels of the system to be cognizant of the types of professional development: formal, informal, and independent that yield the greatest integration of technology in the classroom. Studies have shown that without professional development, technology integration will not happen (Davidson et al., 2014).

Principals will benefit from this study as they will learn that if they establish trust and encourage their teachers to take risks, teachers will be more likely to participate in professional

development activities that provide the greatest benefit for instructional technology integration. Similarly, principals will benefit by knowing that if they work collaboratively with their teachers that the teachers will be more likely to integrate instructional technology. Finally, principals will benefit by learning that being sensitive to the time teachers need to plan, collaborate, and learn assists them in integrating instructional technology. Through these actions, principals will be better able to help teachers overcome existing barriers and beliefs about instructional technology integration and participation in professional development.

Additionally, this research is important to the hiring process used by one-to-one districts. As this study looks at the leadership characteristics most likely to increase the integration of instructional technology, superintendent, assistant superintendent, technology director, curriculum director, and principal hiring committees will be able to use the findings to identify the characteristics desirable for hiring a digital leader. Hiring a digital leader will facilitate the integration of technology and allow for the modeling of the use of technology (Rogers, 2000a; Russell et al., 2004).

Finally, this research has the potential to inform district and school leaders about the requirements for successful one-to-one implementation. Through the findings, leaders will be able to evaluate if the components for successful integration are in place. These components include effective forms of professional development, leadership actions that support teachers in both their professional learning as well as support for integration, and an analysis of existing barriers and beliefs of teachers in their culture that can serve to enhance or sabotage implementation (Holland, 2001; Jones & Dexter, 2014; Parr, 1999; Windschitl & Sahl, 2002).

Definition of Terms

Professional development. Professional development is defined as, "a set of practices intended to change the curriculum as delivered to students in schools" (Ponder, Maher, & Adams, 2010, pp. 858–859).

Formal professional development. Those activities that are arranged by the district, are aligned to district goals, and are held at a predetermined time and place. Examples of such activities include workshops, conferences (both within and outside of the district), in-service trainings, college courses, professional learning communities (PLC), as well as instructional technology personnel employed by the district (Garet et al., 2001; Jones & Dexter, 2014).

Informal professional development. Informal professional development, as defined in this study, includes teachers collaborating in communities of practice (COPs), talking in informal groups (study groups) during preps , lunch, or between classes, internships, and mentoring relationships with technology proficient staff members, other than the district assigned technology integration specialists (Jones & Dexter, 2014).

Independent professional development. Independent professional development are activities that allow for individualized learning through the management and selection of content, co-construction of knowledge, demonstration of competencies, and generation of networks for ongoing learning outside of the school day and on the teacher's own time (Ross, Maninger, LaPrairie, & Sullivan, 2015). Forms of independent professional development include, Google searches, reading wikis and blogs, Facebook, Pinterest, Twitter, participation in Twitter chats, attending EdCamp events, and the development of a professional learning Network (PLN) (Jones & Dexter, 2014).

Middle school. Middle schools as defined by the New York State Department of Education are schools with grades five to seven, five to eight, or six to eight (NYSED, 2015c).

One-to-one computing. One-to-one computing, as defined in this study, are whole schools or grades where every student receives a personal computing device for use across all disciplines, is taken from class to class, and may, or may not be allowed to be taken home at the end of the school day (Dorfman, 2016).

Instructional technology. Standard technologies such as chalk and blackboards to more advanced technologies provided through the internet such as curriculum, videos, learning management systems, and social media for example (Mishra & Koehler, 2006).

Instructional technology integration. Ertmer (1999), defines technology integration as, "the extent to which technology is used to facilitate teaching and learning" (p. 50).

TPACK. TPACK stands for technology, pedagogy, and content knowledge which is a framework that defines what teachers need to know to thoughtful integrate technology in their classrooms (Partnership for 21st Century Skills, 2010).

Digital leadership. A strategic mindset that leverages available resources to improve what we do, while anticipating the changes needed to cultivate a school culture focused on engagement and achievement. It is a transformed construct of leadership that grows out of the leader's symbiotic relationship with technology (Sheninger, 2014).

Instructional leadership. A model of leadership where the principal is seen as the primary source of educational expertise, whose role is to maintain high expectations for teachers and students, supervise classroom instruction, coordinate the school's curriculum, and monitor student progress (Barth, 1986).

Transformational leadership. Transformational leadership provides intellectual direction and aims at innovating within the organization, while empowering and supporting teachers as partners in decision making (Leithwood, 1994).

First order barrier. First order barriers to technology integration are extrinsic to teachers and include such items as access to technology and software, time, and administrative support. (Pierce & Ball, 2009, p. 48).

Second order barriers. Second order barriers to technology integration are intrinsic to teachers and include teacher beliefs about teaching, computers in general, classroom practices, and their unwillingness to change (Pierce & Ball, 2009, p. 48).

Assumptions

There are several assumptions inherent in this paper. First, it is assumed that teachers attend professional development annually whether they choose to do so on their own or they are required to do so (Caynon, 1982; Davis, Preston, & Sahin, 2009). This assumption is necessary as this study seeks teacher responses to attendance at the various forms of professional development (formal, informal, and independent). Further, it is assumed that, the building principal is integral to helping teachers select, develop, and attend professional development to support them in integrating instructional technology in their classrooms (Parr, 1999). Again, the survey instrument utilized in this study relies on teacher responses concerning principal actions for encouraging professional development and integrating instructional technology.

In terms of instructional technology integration, it is assumed that most teachers in one-to-one schools attempt to integrate technology in their classroom and do so with more frequency after attending professional development (Pritchett, Pritchett, & Wohleb, 2013). However, the reality

is that many teachers still fail to integrate instructional technology and this will most likely be the case in this study as well (Mishra & Koehler, 2006). This is an acceptable assumption as teachers who attend instructional technology professional development will do so as the professional development is "just in time," versus "just in case" (Hixon & Buckenmeyer, 2009). It is also assumed that building principals of one-to-one schools believe that having the devices and integrating them into the curriculum will increase student learning and engagement (Beytekin, 2014). While this assumption may or may not be true, research exists indicating the importance of the principal for student achievement (Chang, 2012).

Research also indicates, the need to remove barriers to technology integration and the need for changing teacher beliefs about both professional development and technology integration (Ertmer, 1999; Galvis, 2012). Therefore, it is assumed that the teachers in this study will likely report many of the same barriers and beliefs teachers have reported in previous studies. This assumption is allowed because instructional technology integration is impacted by first and second order barriers and these exist for all teachers, in all classrooms (Levin & Wadmany, 2008).

Limitations of Study

Long Island represents a part of New York State that is more affluent than other parts of the state and thus, the schools are more likely to implement one-to-one initiatives than other parts of New York State (NYSED, 2015c). This study also excludes New York City, including the boroughs of New York City that are geographically situated on Long Island (Casserly, Jepson, Williams, Lewis, & Council of the Great City Schools DC., 2000). New York City has many more students and teachers and is funded and governed differently than Nassau and Suffolk County school districts (New York City Department of Education, 2016). Therefore, the results of this

study may not hold true for findings in New York City. Additionally, there were no high needs district teachers surveyed for this study and the results cannot necessarily be extrapolated to this population.

However, these limitations will not adversely affect the outcomes of this study as the demographic factors of gender, race, English language learners, and students with disabilities is similar to all other parts of New York State excluding New York City (NYSED, 2015a). Similarly, just because high needs districts were excluded from this study, one cannot assume high needs districts do not interpret technology integration the same as low and average needs districts.

As each of Long Island's 125 school districts were asked to self-report if they had at least one grade in their middle school with one-to-one computing, it is unclear if there are other districts who may have a one-to-one grade in their middle school who did not self-report.

Sample size was another limitation of this study. The methodology employed in this research utilized surveys of middle school teachers working in one-to-one classrooms. Fryrear (2015), has found that when a researcher has no association to the people being surveyed, the survey return rate ranges from 10 to 15 percent. Knowing this, of the 1040 teachers surveyed, the expected return rate should be approximately 104 to 156 respondents.

An additional limitation would be that only teachers are being surveyed about their perceptions of their principal's actions. This study does not survey the principal about their actions in relation to encouraging teachers to attend instructional technology professional development or the actions they believe they take to support and encourage instructional technology integration. Although comparing these findings to the findings from the teachers would be relevant, this study does not seek to identify the relationships between these two populations.

Finally, while preparing for this analysis, it was determined that the not applicable (N/A) responses for all survey questions with such a choice would be omitted. In each question where this option appeared, it is the researcher's belief that either an action occurred or it didn't occur. Although the survey allowed for the selection of N/A, a nondefinitive response, this response does not support the relationships the research questions were addressing. This reasoning will be applied across all variables when a yes/no construct is used to address a research question.

Delimitations

This study surveyed 1040 middle school teachers on Long Island, New York teaching in a one-to-one classroom. Middle schools were selected for this study as many one-to-one initiatives are started in these settings due to the correlation that exists between middle school philosophy and the philosophy of implementing a one-to-one initiative (National Middle School Association, 1993). As such, this study is delimited to only this population and does not address elementary or high school teachers.

The sample size of 1040 represents 300 teachers from Suffolk County and 740 teachers from Nassau County. This represents the same percentage of teachers per county as the number of schools in each county who self-reported that they had a one-to-one grade in their middle school from each county. Therefore, it was decided that this sample would yield enough responses to be considered representative of this population.

Additionally, this study only surveys teachers in one-to-one classrooms and does not address the issue of instructional technology integration in schools without one-to-one initiatives as this area has been researched (Lawless & Pellegrino, 2007; Levin & Wadmany, 2008). Although there are certain similarities concerning professional development and instructional

technology integration in both, this study seeks to identify these similarities and differences for one-to-one teachers and their classrooms.

Organization of the Study

This dissertation is organized into five chapters. Chapter One outlines the introduction and the purpose of the study along with the research questions. Chapter Two presents the background literature for the study. Chapter Three explains the research methodology and the procedures followed for conducting the research. Chapter Four contains the analysis of the data. The final chapter, Chapter Five summarizes the conclusions, findings, and recommendations.

Chapter 2:
Review of the Literature

Introduction

As schools have shifted from traditional instruction to digital instruction, many districts and schools have begun initiating one-to-one environments (Herold, 2016). One-to-one computing, as defined in this study, are whole schools or grades where every student receives a personal computing device for use across all disciplines, is taken from class to class, and may, or may not be allowed to be taken home at the end of the school day (Dorfman, 2016). The primary rationale for these initiatives include increased student achievement and increased student engagement (Penuel, 2006; Russell et al., 2004; Zucker & Light, 2009). However, with the large number of fiscal resources being spent on these initiatives, there has been a demand for accountability that these devices be integrated into instruction (Spires, Oliver, & Corn, 2012).

To ensure these devices are integrated seamlessly into classroom instruction, school systems have provided a variety of instructional technology professional development opportunities for teachers (Jones & Dexter, 2014). Through effective and meaningful professional development (Garet et al., 2001), it is expected teachers will be able to change teaching methodologies and integrate instructional technology into their instruction (Sheumaker et al., 2001). In addition, the role of the principal cannot be diminished in importance as it has been found that both teacher participation in instructional technology professional development and instructional technology integration are facilitated by the leadership actions of principals (Chang et al., 2008; S. L. Dexter, 2011; ISTE, 2009).

The purpose of this study was to examine the relationship between formal, informal, and independent professional development offerings, the leadership actions of principals and teacher biases and barriers, and their influence on public middle school teachers' integration of instructional technology in a one-to-one environment. This quantitative, correlational design study will be examined through the conceptual framework of Digital Leadership and the Technology, Pedagogy and Content Knowledge (TPACK) framework. The unit of analysis for this study was public middle school teachers of grades five through eight teaching in a one-to-one environment on Long Island, New York.

To support the purpose of this study, the literature in this chapter will be presented in four sections. The first section will briefly describe the history of one-to-one computing and the reasons districts choose to implement these initiatives in their schools. Contained within this section will also be a discussion of successful and unsuccessful implementations of these initiatives. One-to-one initiatives are successful when instructional technology integration is supported with effective professional development and positive digital leadership.

The second section describes instructional technology integration and how this creates the conditions for successful one-to-one implementation. This section concludes with an examination of instructional technology integration through the technology, pedagogy, and content knowledge (TPACK) framework (Harris, Mishra, & Koehler, 2009).

The third section discusses instructional technology professional development, including an overview of effective professional development, and the three forms of professional development: formal, informal, and independent professional development. Additionally, beliefs and barriers that impede teachers from participating in and/or transitioning from instructional technology professional development to instructional technology integration will be discussed.

Finally, the fourth section discusses how leadership creates a supportive culture of instructional technology professional development and promotes the integration of instructional technology for student achievement. This will be viewed through the framework of digital leadership, which is related to instructional and transformational leadership (Sheninger, 2014).

Inherent to both effective professional development and successful instructional technology integration is the removal of barriers to technology and a change in teacher beliefs about the value of technology for delivering curriculum and changing pedagogy.

One-to-One Computing

One-to-one computing initiatives involve providing each student with their own personal computing device to be used in all subjects (Dorfman, 2016). In 2006, one-to-one computing was listed as one of the most significant educational technology stories by *eSchool News* (eSchool News Staff Reports, 2006), and by 2013-2014, more than 23 million technology devices were purchased for classroom use alone (Herold, 2016). This trend in purchasing is reinforced by the fact that more school leaders are reporting that their communities are becoming more supportive of technology purchases (Networking, 2004). With this support, and the belief that increased access will lead to more computer use by students, more leaders have been willing to decrease the student-to-computer ratio and move forward with one-to-one computing (Russell et al., 2004). Additionally, as the cost of the one-to-one devices has declined, leadership interest in adding one-to-one computing has increased (O'Hanlon, 2007; Zucker & Light, 2009). Nowhere has this increase been greater than in middle schools where one-to-one computing has flourished due to the flexibility in the middle school curriculum and the student-centered approach to instruction that one-to-one devices can provide (Downes & Bishop, 2015).

History. The initial implementation of one-to-one initiatives dates back to the 1980's and was called the Apple Classrooms of Tomorrow Project (Strudler, Donovan, & Hartley, 2011). This was followed closely by a one-to-one initiative at the Methodist Ladies College in Melbourne, Australia in 1989, which required all incoming students in grades 5 through 12 to purchase a school-approved Toshiba laptop (Bebell & Kay, 2010; Russell et al., 2004).

In the United States, the first statewide one-to-one initiative was the Maine Learning Technology Initiative (MLTI) which was started in 2002 by Governor Angus King (McCarthy & Breen, 2001). This large-scale initiative provided laptops to 17,000 students in over 240 schools across the state of Maine (Garthwait & Weller, 2005; Gravelle, 2003). Another large-scale initiative was the Texas Technology Immersion Pilot (TTIP), which was authorized by the Texas legislature in 2003, and provided 20 million dollars for high needs middle schools in Texas (Texas Center for Education Research, 2004). Around the same time, The Michigan Freedom to Learn (MFTL) program, a statewide initiative, was started in 2003 with start-up funds totaling $7.5 million, and coordinated by the Michigan Department of Education and Ferris State University in Big Rapids (McHale, 2006). Three years after its inception, the program targeted underperforming middle schools in 100 of the state's 500 districts with more than 23,000 students and 1,500 teachers (McHale, 2006).

The next large-scale initiative was Pennsylvania's Classrooms for the Future program which was enacted in 2006-07, and provided $20 million for 16,000 computers in 1200 classrooms which supplied classroom sets of laptops, plus $6 million for professional development (Pennsylvania Department of Education, 2006). Examples of international one-to-one initiatives include Uruguay, who distributed 120,000 laptops with plans to buy 300,000 more, Portugal, who will provide 500,000 computers to students, and Venezuela, who has ordered one million laptops

for children (Zucker & Light, 2009). These initiatives have laid the groundwork for one-to-one computing worldwide and this is evidenced by the fact that prior to 2004, most studies only dealt with student ratios of ten-to-one, with very few studying ratios of one-to-one (Russell et al., 2004).

Why one-to-one? The reasons that districts accelerate the implementation of 1:1 programs are numerous, yet the most often mentioned reason to implement a one-to-one initiative is to improve academic achievement by allowing students greater freedom to access information (K. Dawson, Cavanaugh, & Ritzhaupt, 2008; Garthwait & Weller, 2005; Hayes & Greaves, 2013; Penuel, 2006). The second most often mentioned reason for one-to-one implementation is increased student engagement through delivery of lessons that are more relevant to students' lives (Downes & Bishop, 2015; O'Dwyer, Russell, & Bebell, 2005; Russell et al., 2004). Additional reasons include increased equity for all students (Swan et al., 2005; Zucker & Light, 2009), improved home-school relationships (Russell et al., 2004), and bridging the digital divide (Gravelle, 2003).

However, there are challenges to creating successful one-to-one programs. For example, Dunleavy, Dexter, and Heinecke (2007) found varying levels of fidelity of implementation between various one-to-one computing districts. When implemented successfully, the benefits to student learning are demonstrable; while poor implementation leads to ill-will from many stakeholders (Ertmer, 2005; Zucker & Light, 2009). The next sections examine components of successful implementations and the benefits yielded followed by the reasons for unsuccessful implementations.

Successful implementation and positive student outcomes. Successful changes in classrooms need to address existing concerns and beliefs about the delivery of instruction; this is particularly true with one-to-one computing implementations (Hall & Hord, 2001). To address

these concerns and beliefs, a clear vision, effective professional development, digital leadership, curriculum integration, and time for integration are required.

Effective leadership requires a clear vision when initiating change (Bennis, 2009; Kotter, 2012). Therefore, laying out a clear vision with supporting goals helps ensure successful one-to-one implementations (Donovan, Green, & Hartley, 2010; Herold, 2016; McLeod, 2015). Successful one-to-one implementations also require effective professional development to help teachers become more student-centered (Penuel, 2006), address teachers' concerns and beliefs (Penuel, 2006; Strudler et al., 2011; Windschitl & Sahl, 2002), and meet teachers' existing level of technological abilities (K. Dawson et al., 2008; Downes & Bishop, 2015).

Additionally, leadership that supports teachers and helps create a shared purpose and buy-in for using technology in the classroom is important for a successful one-to-one implementation (Dexter, 2011; Shapley, Sheehan, Maloney, & Caranikas-Walker, 2011). Leaders need to help teachers examine their beliefs about one-to-one computing and what having these devices means to the way they deliver the curriculum. Downes and Bishop (2015) found curriculum that is "active and purposeful, challenging, and relevant, and creative and individualized create the conditions for successful one-to-one implementation" (p. 12). Furthermore, to accomplish these curricular enhancements, leaders need to provide teachers with the time to collaborate and plan (Windschitl & Sahl, 2002). With these keys to successful implementation, one-to-one computing offers benefits to teaching and learning.

With successful implementation come positive outcomes for students and their learning. The number one positive outcome of one-to-one initiatives is that teaching becomes more relevant (Hammond, Reynolds, & Ingram, 2011; Swan et al., 2005) and learning becomes more student-centered (Dawson et al., 2008; Penuel, 2006; Bebell & O'Dwyer, 2010; Russell et al., 2004). This

is accomplished through technology-based activities and an increase in small group interactions (Russell et al., 2004; Shapley et al., 2011). Not only does the learning become more student-centered, but it also becomes personalized and individualized (Dunleavy et al., 2007; U.S. Department of Education, 2016). The learning becomes individualized and personalized as students learn and demonstrate understanding in a variety of modalities such as communication, expression, or exploration (Lei & Zhao, 2008). Additionally, teachers and students have the opportunity to differentiate both how learning occurs and how learning is measured (Keengwe & Onchwari, 2009). This is accomplished through applications that allow for personalized assessment as well as applications that tailor lessons based on the performance targets from the assessment applications.

Lastly, Spires, Oliver, and Corn (2012) found there was a change in relationships between stakeholders, the school, its pedagogy, and its place in the community when one-to-one computing was implemented. Where one-to-one initiatives have been implemented, teachers respond and communicate with parents more frequently, parents work with students to ensure appropriate digital citizenship, whole communities come together to identify to goals and needs of the one-to-one-initiative, and teachers and students report greater access to information for teaching and learning (Bebell & Kay, 2010; Lei & Zhao, 2008; Weston & Bain, 2010) These are just a few of the benefits one-to-one computing brings to the school community. However, just as thoughtful implementation creates positive outcomes, poor implementations creates negative outcomes (Penuel, 2006).

Challenges of one-to-one technology implementation. Despite the fact that schools have continued to increase the amount of technology in schools and the amount of money dedicated to these resources, the overall impact on instruction has been minimal in many places (Ertmer &

Ottenbreit-Leftwich, 2010; Hixon & Buckenmeyer, 2009), and this impact is not isolated to the United States (Davidson et al., 2014). *In Oversold and Underused: Computers in the Classroom* (2001), Cuban found that large investments in computers for schools often have minimal effects on the learning environment. In part, this minimal effect of the learning environment is attributable to a lack of clear vision when initiating one-to-one programs; many schools initiate these programs because neighboring districts are doing it, or because it allow the district to showcase how taxpayer dollars are being spent and tied to the classroom (McLeod, 2015; Pierson, 2001).

When the vision of the one-to-one initiative is not clear, conditions are ripe for failure of these initiatives as the implementation alone does not create the conditions for changes to student achievement or student engagement. Instead, having teachers who are willing to change and modify their instruction will create the greatest changes to student achievement and engagement (Garthwait & Weller, 2005; Keengwe & Onchwari, 2009). When teacher beliefs are not changed, teaching does not shift to being more student-centered and advances in student achievement or student engagement are never realized (Donovan et al., 2010; Garthwait & Weller, 2005; Hur & Oh, 2012). However, technology has the ability to serve as a catalyst for teachers to transform their teaching and learning, which in turn changes their pedagogy and beliefs for increased student achievement (Spires et al., 2012; Windschitl & Sahl, 2002).

Hixon and Buckenmeyer (2009) suggest that although we are learning more about what teachers need to do to effectively integrate technology in one-to-one schools, districts are missing the point when it comes to training, as they are focusing too much on training for technology and missing or omitting the change in teacher beliefs when it comes to professional development offerings. To address this, professional development should focus on teacher beliefs about what is good teaching and how technology is situated and supported in the context of content and

curriculum (Windschitl & Sahl, 2002; Zucker & Light, 2009). To accomplish these shifts, teachers need training in content, assessment, and pedagogy in addition to technology for gains in the one-to-one classroom to become a reality.

Summary

One-to-one initiatives hold great promise for increased student achievement and engagement when implemented well. However, there is great potential for problems to surface and this is when effective instructional technology professional development and technology integration becomes ever more important (Dunleavy et al., 2007; Zucker & Light, 2009). The next section discusses instructional technology integration and describes how a school's culture, teacher beliefs about instructional technology in the classroom, the curriculum, and a teacher's pedagogy combine to create barriers to successful instructional technology integration. Further, the technology, pedagogy, and content (TPACK) framework will be discussed as a model to overcome these barriers.

Instructional Technology Integration

This section examines effective instructional technology integration with connections to the TPACK framework as well as its importance to one-to-one computing initiatives. Instructional technology integration has been studied widely for years, and yet, it still remains elusive for the vast majority of schools, including those implementing one-to-one computing initiatives (Ertmer & Ottenbreit-Leftwich, 2010). Although there are several technology integration frameworks in existence, the two frameworks most widely referenced and utilized in education are, the technology, pedagogy, and content knowledge framework (TPACK), and the substitution, augmentation, modification, and redefinition framework (SAMR) (Edutopia Staff, 2007). The

model for instructional technology integration examined in this study is the TPACK framework, formulated by Mishra and Koehler (2006), derived from the work of Shulman (1986).

Technology integration has been defined by Hew and Brush (2007) as, "the use of computing devices for instruction," (p. 225), while similarly, Ertmer (1999), defines technology integration as, "the extent to which technology is used to facilitate teaching and learning" (p. 50). The reasons for integrating instructional technology into classroom instruction are as varied as the devices utilized in one-to-one initiatives. However, the more a device becomes part of mainstream society, the more likely it will be used by teachers and students, and thus be integrated into the curriculum (Cuban et al., 2001; Lumpe & Chambers, 2001).

Successful technology integration builds excitement about the possibilities for teaching and learning. When schools institute one-to-one initiatives, teachers get excited about the new possibilities for students and the curriculum (Levin & Wadmany, 2008). Additionally, teachers imagine the possibilities integration brings by, "making it quicker or easier to teach the same things, while at the same time making it possible to adopt different approaches to instruction and/or change the content or context of learning" (Lawless & Pellegrino, 2007, p. 575). Successful technology integration also has the ability to increase student achievement, their skills, and prepares them to be college and career ready (Lowther, Inan, Strahl, & Ross, 2008; Schrum & Levin, 2013). Lastly, widespread technology integration in schools helps teachers become more collaborative with their colleagues and plan more efficiently for the integration of technology into instruction (Cuban et al., 2001).

However, the level of instructional technology integration is influenced by such factors as the existing school culture and teacher beliefs about the usefulness of technology in the classroom, variations in professional development, leadership at the school level, and existing curriculum and

pedagogy (Brinkerhoff, 2006; Davidson et al., 2014; M. Golden, 2004; Palak & Walls, 2009; Skues & Cunningham, 2013).

Culture. Existing school culture and the social networks within them can create the conditions for either positive or negative beliefs and actions to integrate instructional technology (Daly, 2015; Frank, Zhao, & Borman, 2004; Levin & Wadmany, 2008). Research by Windschitl and Sahl (2002) has shown that in schools where more teachers integrate technology, an environment is created where another teacher will integrate technology. In addition, schools that have a culture of collaboration see a greater level of technology integration (Parr, 1999). Another cultural value in schools is time. In schools where there is a culture of respect for teachers' time for professional development, collaboration, and planning, there exists a higher level of technology integration (Machado & Chung, 2015). School culture can serve as an enticement, or a barrier, for teachers to integrate instructional technology.

Barriers to instructional technology integration. Lowering or changing teachers' perceived barriers to instructional technology are integral to instructional technology integration. According to Ertmer (1999), barriers can be sorted as either first, or second order (Table 1). First-order barriers are extrinsic to the teacher, whereas second-order barriers are more intrinsic to teachers. First order barriers include resources, institutional and administrative support, and practices and expectations within each subject, known as subject culture (Hew & Brush, 2007). Second order barriers include training and experience, attitudinal or personality factors, knowledge, and skills and assessment; these are teachers' personal beliefs that may hinder the implementation of technology integration in classrooms (Ertmer, 1999; Tsai & Chai, 2012).

Table 1

First vs. Second Order Barriers

First Order Barriers: barriers that are extrinsic to the teacher and imposed by external forces	Time, technology support, access to technology, budget, school and district policies, and change leadership
Second Order Barriers: barriers that are intrinsic to teachers and involve changing beliefs about technology and teaching with technology	Beliefs and knowledge about content and its delivery, about available technologies, how to use them in instruction and their benefits to student learning, and about effective pedagogy to address individual and group learning.

Specifically, first order barriers include time, support, budget constraints, school policies, and leadership. When it comes to first order barriers, time ranks as the number one barrier to technology integration, followed closely by support (Duran, Runvand, & Fossum, 2009; Lu & Overbaugh, 2009; Skues & Cunningham, 2013). The time most teachers mention is that used for collaboration and planning, reviewing resources, and identifying and attending professional development (Cuban et al., 2001; K. Dawson, 2012; Windschitl & Sahl, 2002).

Pritchett, Pritchett, and Wohleb (2013) identified budget and district policy constraints as another set of barriers teachers face when attempting to integrate technology into the curriculum. They found that without the necessary funds to support technology, integration would be impossible. Similarly, policies, or the lack thereof, concerning the evaluation of technology and the methods for assessing their effectiveness can create barriers to technology integration if teachers do not understand why a technology is in the classroom in the first place or how its effectiveness in the content area was assessed (Keengwe & Onchwari, 2009; O'Dwyer et al., 2005).

Lastly, ineffective leadership practices were also reported as being a major barrier to effective instructional technology integration (Duhaney, 2001). Leadership through times of change is essential (Hall & Hord, 2001; Leithwood et al., 2004). Leaders that are purposeful about implementing change, and who can reduce the number of changes happening at the same time, see a greater level of integration by teachers (Zhao & Frank, 2003). However, there are some changes that are out of the local school's control such as new state curricula and state testing which exist as barriers to time for instructional technology integration and hinder a leader's ability to help teachers manage the change. Each of these first order barriers exist beyond the scope of the teacher's influence.

Second order barriers are more intrinsic to the individual teacher, their teaching, and their classroom (Bailey, 1997; Ertmer, 1999; Hammond et al., 2011). Examples of second order barriers include beliefs and knowledge about: content and its delivery, available technologies and how to use them in instruction and their benefits to student learning, and effective pedagogy to address individual and group learning (Windschitl & Sahl, 2002). These barriers may be more difficult to overcome than first order barriers, as these are part of a teacher's beliefs about teaching and learning. For example, if a teacher believes writing with a pen on paper is the best way to help a student understand the writing process, these teachers will most likely not believe technology can ameliorate this task. Resolving these barriers could be attained through professional development and exemplary examples of student writing where technology was used instead of a pen and paper.

Thus, teacher beliefs about curriculum, pedagogy, and technology have been shown to be the greatest predictors of, and obstacles to, technology integration (Cuban, 2001; Lumpe & Chambers, 2001; Palak & Walls, 2009). Windschitl and Sahl, (2002) found that teachers' belief systems about learners in their school, about what constituted good teaching in their school, and

about the role of technology in the lives of their students, mediated the instructional decisions they employed in the classroom. Therefore, teachers who see the positive benefit of using technology in their instruction will be more likely to change their beliefs and integrate technology (Pierce & Ball, 2009; Sheumaker et al., 2001; Windschitl & Sahl, 2002). As second order barriers are more personal to each individual teacher, overcoming these barriers are often more difficult to achieve. This has been reinforced by Hixon & Buckenmeyer (2009), who state that schools are missing the point by focusing too much on first order barriers.

Although not addressed in this research, Tsai & Chai (2012), have hypothesized a third order barrier, known as design thinking. They articulate that because the classroom and students are dynamic, teachers need to rethink and reorganize teaching materials to adapt to the needs of different learners and different learning situations. Thus, the barriers to instructional technology integration are numerous, and the solution to technology integration appears to be in how these barriers can be lowered or outright removed.

Once the barriers to instructional technology integration are acknowledged, solutions can be provided to alleviate these barriers and change beliefs to allow for effective instructional technology integration. Some highlight that barriers may begin even before a person begins teaching (Ertmer, 2005). Only twenty-five percent of teacher candidates report being taught how to integrate technology in instruction, with most training in technology being in the use of word processing and spreadsheet programs (Project Tomorrow, 2010). Although training in technical skills is necessary, integration of technology in instruction is of equal or greater importance (Pritchett et al., 2013).

However, once a person enters the profession, there are proven strategies to address these existing beliefs and barriers. Ertmer (2005), recommends the following methods to change beliefs and allow for technology integration:

> Form small communities of practice, in which teachers jointly explore new teaching methods, tools, and beliefs, and support each other as they begin transforming classroom practice; provide opportunities for teachers to observe classroom practices, including technology uses, that are supported by different pedagogical beliefs; introduce technology tools gradually, beginning with those that support teachers' current practices and expanding to those that support higher level goals; provide ongoing technical and pedagogical support as teachers develop confidence and competence with the technological tools, as well as the new instructional strategies required to implement a different set of pedagogical beliefs (p. 35).

To lower these barriers and change teacher beliefs about second order barriers, these solutions require effective professional development and capable digital leadership.

Professional Development and Leadership. In addition to the strategies listed above, research indicates that both professional development and leadership lower barriers, change beliefs, and impact a teacher's willingness to integrate instructional technology in their classrooms (Chang, 2012; Hixon & Buckenmeyer, 2009). Just as there are first and second order barriers to instructional technology integration, there are also first and second order barriers to professional development (Ertmer, 1999; Levin & Wadmany, 2008). Examples of first order barriers would include time to attend professional development, professional development offerings, the cost of professional development to the teacher, and the available resources after professional development is taken. While second order barriers would include a belief in the value of

instructional technology professional development, the belief that the teacher can change and wants to change pedagogy after attending professional development, and the belief that attending professional development will impact their students in a positive manner (Hixon & Buckenmeyer, 2009). Similarly, leading people through times of change requires effective digital leadership, and instructional technology integration is a form of change to the institution of school (Kotter, 2012). Both professional development and leadership will be discussed more fully later in this chapter.

Curriculum. Even with the appropriate amount of professional development and an effective digital leader, infusing technology in the curriculum remains elusive for most schools and districts (Plair, 2008). The challenge is to find the best way to infuse technology into the existing curriculum (Davidson et al., 2014). This challenge exists because technology and the curriculum are ever evolving (Mishra & Koehler, 2006). Therefore, technology that is married to the curriculum and matches a teacher's existing beliefs has the greatest chance of being integrated (Hixon & Buckenmeyer, 2009).

The International Society for Technology in Education (ISTE) Standards for teachers state that teachers should facilitate and inspire student learning and creativity through their knowledge of subject, teaching, and learning (ISTE, 2008). In order to achieve this, teachers should strive to make their instruction as student-centered as possible (Hixon & Buckenmeyer, 2009). The goal is to modify curriculum to facilitate meaningful learning and include technology that students are familiar with to construct knowledge that can be applied to real life situations (Davidson et al., 2014; Downes & Bishop, 2015; Ertmer & Ottenbreit-Leftwich, 2010). Meeting these needs requires designing instruction that is, "active and purposeful, challenging and relevant, and creative and individualized" (Downes & Bishop, 2015, p. 12).

While modifying the curriculum is necessary, it is equally necessary for teachers to adjust assessments. Students should be provided with multiple and varied formative and summative assessments aligned with content and technology standards. Further, teachers should be able to use the resulting data to inform learning and teaching (ISTE, 2008). Nevertheless, Dawson, Cavanaugh, and Ritzhaupt (2008), found that assessment practices have remained unchanged in one-to-one classrooms even after professional development was provided. As curriculum knowledge supports student achievement, it becomes ever more important that the skills of teachers be developed in the areas of curriculum and assessment to meet the broad range of students they teach every day (K. Dawson, 2012; Hokanson, Hooper, & The Association for Educational Communications and Technology, 2004). Although changes to curriculum and assessment assist instructional technology integration, pedagogical changes are also needed to achieve true instructional technology integration.

Pedagogy. If technology integration is to be attained in the classroom, teachers need to have an understanding of the instructional practices needed to use technology while teaching the curriculum (Pierson, 2001). Therefore, professional development needs to aim at developing teacher beliefs about effective teaching and the changing role of the teacher in the classroom (Windschitl & Sahl, 2002). This would include utilizing the pedagogical approaches of student-centered learning activities such as experiential, hands-on learning, independent inquiry/research, and cooperative learning (Ertmer, 2005; Lowther et al., 2008; Palak & Walls, 2009). By doing so, teachers will be better able to meet the ISTE Standards for teachers which state, “teachers should design, develop, and evaluate authentic learning experiences and assessments by incorporating contemporary tools and resources to maximize content” (ISTE, 2008, p. 1).

Thus, it stands to reason that constructivist teachers, those who believe understanding comes through experiences, would be more apt and better able at integrating instructional technology than traditional teachers. In fact, several studies have found that moving toward a more constructivist approach is preferable and does create the conditions of changed teacher beliefs and increases technology integration for the purpose of increased student involvement and achievement (Chang, 2012; Keengwe & Onchwari, 2009; Levin & Wadmany, 2008). At the same time, research by Lumpe and Chambers (2001) found that those teachers who hold a combination of constructivist and traditional teaching profiles had the highest degree of instructional technology integration. It is also worth mentioning that having technology alone will neither cause a teacher to be constructivist, nor integrate instructional technology (Windschitl & Sahl, 2002). This would indicate that a good teacher, no matter their style, could find ways to integrate instructional technology into their instruction.

The framework for technology integration examined in this research is the technology, pedagogy, and content knowledge (TPACK) framework. The TPACK framework allows us to examine how best to professionally develop teachers' knowledge in the areas of content, technology and pedagogy while at the same time, assists in developing better learning environments for student through instructional technology integration (Mishra & Koehler, 2006).

TPACK

TPACK stands for technology, pedagogy, and content knowledge and is a framework that defines what teachers need to know to thoughtful integrate technology in their classrooms (Partnership for 21st Century Skills, 2010). The TPACK framework is derived from the work of Lee Shulman (1986) who found that content and pedagogy were being studied in isolation of one

another. Through Shulman's (1987) research, he identified four main sources of a teacher's knowledge base: scholarship in content, materials in schools such as curricula and textbooks, existing research on teaching and learning, and teacher practice itself. Furthermore, he suggests that during active teaching, there are transformations that occur on a regular basis; evaluations and reflections occurring that requires the teacher to combine both their content knowledge and their pedagogical knowledge (PCK). Edwards (1998), explains further by suggesting that a teacher's content knowledge and pedagogical knowledge is the main influence on whether and how a teacher utilizes technology in their classrooms.

Expanding on Shulman's work, Mishra and Koehler (2006) found that teaching requires, "an understanding of the relationship between technology, content, and pedagogy to develop appropriate context-specific strategies and representations" (p. 1029). Combining all three is complex and requires teachers to navigate previous pedagogical beliefs with new ideas and technology practices (Scott & Mouza, 2007). Looking at the entire framework (Figure 2), can be confusing. It can be simplified by viewing each knowledge separately, but it is of equal relevance to look at them in pairs (Mishra & Koehler, 2006). However, the real power is when all three are taken together. When this happens, the conditions exist for active student learning and engagement (Mishra & Koehler, 2006).

Content knowledge is the actual subject matter that is to be taught or learned while pedagogical knowledge is about the methods of teaching and learning to present the content (Mishra & Koehler, 2006, pp. 1026–1027). In combination, this means that teaching is actually about what is to be taught first and then, how it will be taught second (Shulman, 1987). This combination is also important in the classroom as it will be a predictor as to whether the content will be easy or difficult to learn (Mishra & Koehler, 2006).

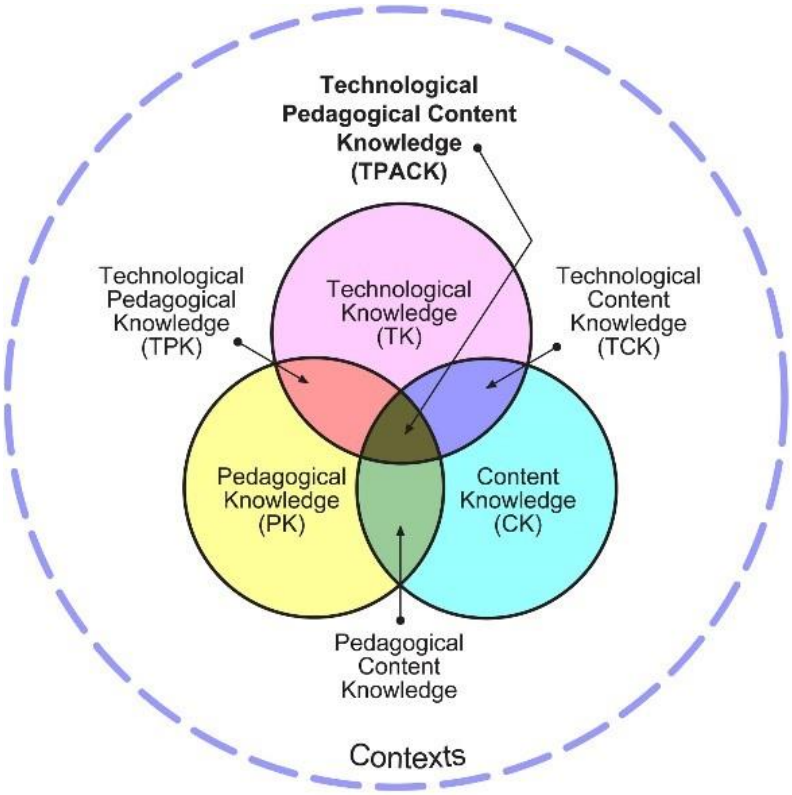

Figure 2. TPACK Framework (http://tpack.org)

Technological knowledge is knowledge about various technologies, and can range from items not considered technology by today's standards (books and chalk and chalkboards) to the internet and digital technologies (Mishra & Koehler, 2006, p. 1027). The problem with technology is that it is often examined in isolation from its use in the classroom, and thus not thought of in terms of how it will be used to support and enhance learning (Plair, 2008). Integrating technology in a lesson is a combination of a teacher's technology and pedagogy knowledge (TPK). Most professional development is aimed at achieving this combination, but most often reverts to focusing on teaching the use of a particular technology tool (Parr, 1999; Walker et al., 2012). In a study by Pierson (2001), it was found that technology leaders would be served well by creating

environments that are conducive to explicit professional development in content, pedagogy and technology.

The goal for effective instructional technology is to combine technology, pedagogy, and content (TPACK) and this combination is at the heart of good teaching with technology (Koehler & Mishra, 2009; Twining et al., 2013). The search for ways to increase the integration of instructional technology has been a topic of research for almost 50 years. The TPACK framework allows for thoughtful integration by incorporating technology into what teachers already do in their classrooms without technology. This knowledge is important for all staff, novice and veteran alike.

To ensure equality of instruction in the classroom, professional development needs to be geared to alter the way teachers teach, and students learn (Plair, 2008). Students with teachers who are not willing to teach with technology face the possibility of inequity and ill preparation for the real world, as compared to those students who have teachers who teach with technology (Zucker & Light, 2009). Thus, teachers who are skilled at TPACK for effective technology integration will be effective in the one-to-one classroom.

Summary

Although technology in schools has been in existence for almost 50 years, the level of technology integration is still severely lacking (Davidson et al., 2014). There is a myriad of factors that influence effective technology integration in schools and many of these factors are similar to the factors affecting effective professional development. In both instances, the major barriers are teacher beliefs about professional development and instructional technology (Levin & Wadmany, 2008; Palak & Walls, 2009). The next section discusses effective professional development, barriers and beliefs about professional development for instructional technology integration, as

well as the differences between formal, informal, and independent professional development and their benefits and detriments to integration of technology in the classroom.

Professional Development

Professional development is defined as, "a set of practices intended to change the curriculum as delivered to students in schools" (Ponder et al., 2010, pp. 858–859). Professional development is also referred to as staff development, continuing education, or in-service training. One-to-one computing, where every student receives an electronic device for use across all disciplines, creates a whole new set of classroom conditions teachers must master in order to present their content in new and meaningful ways (Penuel, 2006). In order for this to happen effectively, teachers must learn a variety of skills and change their practices (Sheumaker et al., 2001). However, each teacher comes to professional development with varying degrees of comfort, experience and beliefs about technology and its usefulness in the classroom (Palak & Walls, 2009). Therefore, professional development when presented in a variety of forms allows teachers the ability to gain various competencies to overcome barriers, change beliefs, learn new skills, and practice implementation in their specific content area (Hiebert & Others, 1996).

Barriers to professional development in instructional technology. Similar to barriers for instructional technology integration, teachers also report barriers to participating in professional development. Whatever reason teachers attend professional development, each teacher comes to professional development with their own personal perceptions, barriers, frustrations, motivations, experiences, and willingness to experiment (Holland, 2001; Mishra & Koehler, 2006; Mouza, 2006). As Levin and Wadmany (2008) describe, "Professional development has the ability to change teacher views from being authoritative to seeing technology integration as an interpretive, interactive and constructivist process that can change others' beliefs

along the way (p 258)." Thus, changing beliefs remains the goal of any professional development (Frederick, Schweizer, & Lowe, 2006). Designing professional development with these factors in mind can serve as a catalyst for successful instructional technology integration.

One of the most mentioned and highly referenced barriers to instructional technology professional development is the point in time in which professional development is delivered. Too often, professional development for technology integration is delivered in a "just in case," setting whereby teachers learn about the technology "in case," they need, or desire to use it in the future (Hixon & Buckenmeyer, 2009). Research has demonstrated that "just in time," professional development (at the point of use and need) leads to greater integration of instructional technology, as the professional development occurs in the teacher's own classroom, in their own school, and sometimes during their own class (Hixon & Buckenmeyer, 2009; Vavasseur & MacGregor, 2008). Removing these barriers requires effective professional development which will be examined in the next section.

Goals of effective professional development for instructional technology integration. Changing teacher beliefs and overcoming barriers to technology integration in the one-to-one classroom can be facilitated through effective professional development (M. Golden, 2004). The International Society for Technology in Education (ISTE) standards for teachers (2008) state teachers should engage in professional growth and leadership, continuously improve their professional practice, and model lifelong learning, by promoting and demonstrating the effective use of digital tools and resources. An examination of the goals and characteristics of effective professional development and professional development for the integration of instructional technology will help clarify what is needed to help teachers realize the goal of successful technology integration.

Before identifying the characteristics of effective professional development, it is important to discuss the goals of effective instructional technology professional development. Penuel (2006) describes the goal of instructional technology professional development as serving to help teachers become more student-centered, acquire new knowledge, change beliefs about the importance of technology in instruction, and allow teachers to exhibit leadership in professional development. In another study that examined how professional development could help English teachers integrate technology in student writing, Scott & Mouza (2007) found,

> Effective professional development should help teachers, enhance their understanding of their subject matter with respect to technology, increase their experience using technology as learners, improve their experience using technology in an instructional setting, assume more leadership responsibilities within and outside their school boundaries, and establish a sense of community that can support classroom implementation of technology (p. 263).

Additionally, Garet et al. (2001) and Hew & Hara (2007), found that effective professional development for technology integration should include a focus on content learning, active learning opportunities tied to specific content, and coherence to school goals, policies, and standards. With these goals in mind, the characteristics of professional development to attain these goals will be examined next.

Characteristics of effective professional development for instructional technology integration. The factor that is most often cited in effective professional development is time. Teachers need time to collaborate with experts, administrators, and their peers to effectively integrate technology after receiving professional development (Beach, 2012; Duran et al., 2009; Jones & Dexter, 2014; Leithwood et al., 2004; Levin & Wadmany, 2008; Mouza, 2006; U.S.

Department of Education, 2016). Teachers also need time to be able to visualize how this new knowledge will transform their classroom and/or improve the academic performance of their students while not placing too much of a time burden on them to learn and implement the practice in their classrooms (Networking, 2004; Penuel, 2006).

Others have found professional development is effective when it is differentiated and treats teacher learners the same way teachers treat the students in their classrooms (Palak & Walls, 2009; Schrum & Levin, 2013; Villano, 2008). In a study by Sugar & Wilson (2005), 95 percent of the respondents indicated a desire to have someone help them with their specific learning needs, thus demonstrating that most teachers desire an individualized, contextualized approach to professional development. Similarly, professional development that meets the teacher's immediate needs goes a long way toward a teacher's integration of instructional technology (Sugar & Wilson, 2005).

Another characteristic of effective professional development for instructional technology integration is professional development that is delivered "just in time." Further supporting "just in time" professional development is Fox (2007), who indicates that teachers need support in the classroom while they are working with their students. This is due to the fact that contextualized, "just in time," professional development allows teachers to practice, reflect, and modify lessons (Glazer, Hannafin, & Song, 2005). However, a contradictory position suggests that providing professional development in the teacher's classrooms limits teachers' learning by only providing technology professional development for instructional technology that is already available to them (Swan et al., 2005). In other words, newer technology learning could be avoided or absent in situated professional development unless introduced by an integration coach.

A final characteristic of effective professional development is the duration of the professional development. There are consistent findings that suggest professional development

delivered with greater frequency and over a longer period of time, is superior to those delivered over one or two sessions (Cuban et al., 2001; Ertmer, 2005; Garet et al., 2001; Jones & Dexter, 2014; Penuel, 2006; Sugar & Wilson, 2005).

Although professional development is necessary for instructional technology integration, not all professional development has the same, if any, impact on instructional technology integration. Frederick, Schweizer, and Lowe (2006) found that teacher satisfaction with a professional development class does not necessarily translate to use in the classroom. Additionally, in a study of one-to-one technology classrooms, extensive training in problem-based learning did not translate to it being incorporated in many lessons (Oliver & Corn, 2008). Therefore, to determine the effectiveness of professional development, the content of the professional development must be measured against the impact it had on teacher knowledge and/or behavior (Lawless & Pellegrino, 2007).

These findings would suggest that teachers need a variety of forms of professional development to be considered effective for the integration of instructional technology. In a large-scale study performed by Overbaugh & Lu (2009), a variety of forms of professional development were recommended for teachers to enhance their teaching skills. To address this need, professional development that is delivered formally, informally, and independently are believed to best address the needs of teachers for instructional technology integration (Table 2).

Table 2

Types of Professional Development *(Jones & Dexter, 2014)*

Type	Examples	Benefits	Limitations
Formal	Workshops, conferences (both within and outside of the district), in-service trainings, college courses, professional learning communities (PLC), as well as instructional technology personnel employed by the district	1. Meets district and school goals 2. PLCs promote collaborative culture and give teacher time to reflect 3. Coaching provides "just in time" support and builds relationships 4. Low cost to deliver 5. Teacher time minimal 6. Delivered to large groups	1. Effectiveness varies based on instructor 2. Lack of context 3. Lack of support 4. Lack of pedagogy 5. Fragmented Learning 6. Minimal interactions with other teachers
Informal	Teachers collaborating in communities of practice (COPs), talking in informal groups (study groups) during preps, lunch, or between classes, internships, and mentoring relationships with technology proficient staff members, other than the district assigned technology integration specialists	1. Teacher collaboration and communication encouraged 2. Learning attached to classroom application 3. More pedagogical knowledge than operational knowledge 4. Learning is on-site, ongoing, and "just in time." 5. Teachers become empowered	1. Information can be based on personal opinion 2. The goals may not be aligned to district or school goals 3. One person can become the knowledge broker 4. Teachers may exhibit information overload 5. Teachers may not have enough time to participate
Independent	Google searches, reading wikis and blogs, Facebook, Pinterest, Twitter, participation in Twitter chats, attending EdCamp events, the development of a professional learning Network (PLN)	1. Teachers manage and select content 2. Synchronous or asynchronous learning 3. Identify with a community of learners 4. Ability to be anonymous 5. Learning from a much larger community 6. More resources in less time	1. Teacher needs to be proficient with new technologies to participate 2. Learning may be from like-minded people 3. Passive participation possible 4. The goals may not be aligned to district or school goals

Formal professional development. Formal professional development, as defined in this study are those activities that are arranged by the district, are aligned to district goals, and are held at a predetermined time and place. Examples of such activities include workshops, conferences (both within and outside of the district), in-service trainings, college courses, professional learning communities (PLC), as well as instructional technology personnel employed by the district (Garet et al., 2001; Jones & Dexter, 2014) In the literature, formal professional development is also referred to as traditional professional development (Fox, 2007; Glazer, Hannafin, Polly, & Rich, 2009; Lawless & Pellegrino, 2007).

One of the most researched forms of formal professional development are PLCs. Although there are multiple models, definitions, and goals of PLCs, for the purposes of this study, the Dufour and Eacker model will be used. Dufour and Eacker (1998) define a PLC as, "educators [creating] an environment that fosters mutual cooperation, emotional support, and personal growth as they work together to achieve what they cannot accomplish alone" (p. xii). Additionally, there are six characteristics of these PLCs: (a) shared mission; (b) vision and values; (c) collective inquiry; collaborative teams; (d) action orientation and experimentation; (e) continuous improvement; and (f) results orientation. PLCs have been given high marks for effective professional development as they promote a collaborative culture where teachers support one another and focus on student results as an outcome, and this can include results via technology (Dufour, 2004). PLCs have also been mentioned as providing teachers the time and space to reflect on their practices (Partnership for 21st Century Skills, 2010). Although some PLCs can be construed to be informal professional development, formal PLCs, "organized by the school with expectations for participation," will be included as formal professional development for this study (Jones & Dexter, 2014, p. 369)

Another form of formal professional development proven effective, involves an instructional technology integration coach who works with teachers to integrate technology. Similarly, Plair (2008) calls these individuals, "knowledge brokers," as they are the people in a school system who keep up with the pace of technological innovations, who are in close proximity to teachers and are thus best situated to fill their gaps in knowledge and understanding. One factor that makes the technology integration coach the most relevant to teachers are the relationships they develop with the teachers in the building (Skues & Cunningham, 2013). Through these relationships, the technology integration coach creates a non-confrontational environment (Sugar & van Tryon, 2014) and this in turn increases teachers' willingness to integrate technology and enhance their overall technology skills (Lowther et al., 2008). The second factor is that the coaches deliver professional development that is "just in time."

Most districts offer, and teachers choose to participate in, formal professional development as the primary form of professional development because of its ease of delivery, its relatively low cost, its alignment with district and school goals, the convenience of times it is offered, and the ability to deliver instruction to a large number of people in a short period of time (Dunleavy et al., 2007). The problem is that formal professional development remains the least useful for changing teacher beliefs and pedagogy (Hixon & Buckenmeyer, 2009; Swan et al., 2005). Thus, formal professional development would be counterintuitive to the goals of effective instructional technology professional development for one-to-one teachers.

There are also multiple studies that have found formal professional development yields the lowest return on investment. In fact, it has been found that "teachers who participate in the traditional professional development workshops are less than 10 percent likely to apply the shared knowledge in their classroom" (Fox, 2007, p. 36). Other studies have similar findings about the

effectiveness of formal professional development (Gilakjani, 2013). Additional shortcomings include a lack of context (Brown & Duguid, 1991; Plair, 2008), a lack of support (Mouza, 2006; Plair, 2008), a plethora of technology learning, but a lack of pedagogical content (Kabilan, Adlina, & Embi, 2011; Schlager & Fusco, 2003), and learning that is fragmented (Lawless & Pellegrino, 2007).

Thus, although there are drawbacks to formal professional development, it will always have a place as a form of effective professional development. Holland (2001) states that "formal professional development should serve a supporting role rather than a starring role when it comes to professional development for the integration of technology" (p. 247).

Informal professional development. Informal professional development, as defined in this study, includes teachers collaborating in communities of practice (COPs), talking in informal groups (study groups) during preps, lunch, or between classes, internships, and mentoring relationships with technology proficient staff members other than the district assigned technology integration specialists (Jones & Dexter, 2014). In general, these activities take place during the day and can also be classified as "just in time," activities as they happen at the moment the teacher is attempting, or thinking of attempting to use the technology in their classroom (Garet et al., 2001).

The effectiveness of informal professional development is more unambiguous than that for formal professional development. The findings show that teachers prefer participating in informal professional development more than formal professional development (Granger, Morbey, Lotherington, Owston, & Wideman, 2002; Schrum & Levin, 2013; Stevenson, 2005; Zhao & Frank, 2003). The primary reasons for this preference is the benefit of increased opportunity for collaboration and communication (Dias, 1999; Duran et al., 2009; Frank et al., 2004; Garet et al.,

2001; Twining et al., 2013; Vavasseur & MacGregor, 2008; Wasko & Faraj, 2000). Additionally, teachers appreciate the ability to apply the learning directly in the classroom (Stevenson, 2005) as well as the inclusion of pedagogical knowledge more than operational knowledge with informal professional development (Lloyd & Mcrobbie, 2005).

The most researched form of informal professional development is communities of practice (COP). COPs are defined as, "a group of practitioners who choose to come together to share information and work together on a problem of practice" (Jones & Dexter, 2014, p. 370). COPs differ from PLCs in leadership (in PLCs the group at large most often provides the information and shares leadership, whereas in COPs there is distributed leadership), membership (in PLCs the membership is usually a forgone conclusion, whereas in COPs membership is voluntary), and knowledge sharing (in PLCs the information is usually shared outside the group and in COPs the information is usually contained within the group) (Blankenship & Ruona, 2007). In general, schools and districts do not organize the activities for an informal COP, but instead, the members choose to join and choose the topic. COPs have been written about extensively and research finds they lead to greater collaboration through sharing with colleagues of varying expertise, provide better "just-in-time" support within the context of the individual's learning, and increased technology integration and support (Hew & Hara, 2007; Kubitskey, Fishman, & Marx, 2003; Ming et al., 2010; Schlager & Fusco, 2003; Vavasseur & MacGregor, 2008; Wasko & Faraj, 2000; Wenger, 1998).

However, potential problems with informal professional development were found during a study by Hew & Hara (2007) who studied COPs. Their first finding was that most of the sharing in these groups was of personal opinion or suggestion, and not of great use for learning to integrate technology. Another finding was that the person who was sharing often took cues from the other

members concerning their interest and often tailored what they shared to other member's interests (Hew & Hara, 2007). Once again, this was not productive in furthering teacher learning for instructional technology integration.

There is additional research discussing the drawbacks to informal professional development as well as COPs in general. One drawback noted by Jones & Dexter (2014), was that informal professional development may not be aligned to district goals. This was echoed by Schlager & Fusco (2003), who concluded that the participation and sharing may be only tangentially related to the district's mission and goals. Another noted constraint is the belief by individuals that they have nothing to contribute or share while participating in informal professional development (Hew & Hara, 2007; Ming et al., 2010; Wasko & Faraj, 2000). Furthermore, the drawbacks to participation in COPs include exclusivity by moderators, teachers not having enough time to participate, and information overload, which leads to a feeling of inadequacy (Riverin & Stacey, 2008).

Independent professional development. Independent professional development include activities that allow for individualized learning through the management and selection of content, co-construction of knowledge, demonstration of competencies, and generation of networks for ongoing learning outside of the school day and on the teacher's own time (Ross et al., 2015). Independent professional development is a relatively new form of professional development and has gained traction with the advent of ubiquitous access to technology and the internet.

Forms of independent professional development include, Google searches, reading wikis and blogs, Facebook, Pinterest, Twitter, participation in Twitter chats, attending EdCamp events, and the development of a professional learning Network (PLN) (Jones & Dexter, 2014). As was true with informal professional development, the reality is that this type of professional

development may, or may not, be aligned to school and district goals (Jones & Dexter, 2014; Schlager & Fusco, 2003). However, learners who participate in this form of professional development are life-long learners who take responsibility for their own professional growth (Dede, 2006). As this form of professional development relies on assorted technologies, one of the drawbacks, limitations and barriers is the need for teachers to be proficient with these technologies (Jones & Dexter, 2014).

Just as there are a variety of reasons teachers participate in formal and informal professional development, so too are there a variety of reasons teachers participate in independent professional development. Hur & Brush (2009) describe why teachers participate in online communities and found there are five reasons why teachers choose to participate in these forums: "(a) sharing emotions, (b) utilizing the advantages of online environments, (c) combating teacher isolation, (d) exploring ideas, and (e) experiencing a sense of camaraderie" (p. 290-291). Similarly, Hew & Hara (2007) identified four main motivators for sharing in these communities which include:

> (a) Collectivism: teachers share knowledge to improve the welfare of community members, (b) reciprocity: teachers want to share knowledge because they have received help from others and want to give back, (c) personal gain: sharing knowledge helps teachers gain new knowledge, and (d) altruism: teachers feel empathy for other teachers' struggles and would like to support them by sharing suggestions. (p. 583)

Advantages of independent professional development are numerous and allow teachers to move from being isolated to a community of life-long learners (Hew & Hara, 2007; Ross et al., 2015; Trust, 2012; Vavasseur & MacGregor, 2008). With independent professional development, the time in which the learning occurs can be at the discretion of the learner and may be synchronous

or asynchronous, and is usually free of charge (Loving, Schroeder, Kang, Shimek, & Herbert, 2007; Ross et al., 2015). As was the case with certain forms of formal and informal professional development, this form of learning can also be "just in time," thus allowing the learning to happen in context with what is being taught (Granger et al., 2002; Riverin & Stacey, 2008; Ross et al., 2015).

With independent professional development, the learning can extend well beyond the district boundaries to the whole world (Beach, 2012; Killion, 2011; U.S. Department of Education, 2016). Finally, with independent professional development, the learner has the option of being anonymous, which reduces the fear of sharing as well as the feeling of inadequacy related to participate in the group (Hur & Brush, 2009).

As an extension of independent professional development, many educators have developed their own professional learning networks (PLNs) composed of predominantly people they only know virtually, and with whom they share resources and understanding for one another's professional development (Trust, 2012). "PLNs are defined as a system of interpersonal connections and relationships and resources that support information learning" (Trust, 2012, p. 133). According to Trust (2012), there are two types of PLNs: information aggregation and social media PLNs. Information aggregation PLNs do not require very much interaction on the part of the participant and include reading blog posts, participating in listservs, email subscriptions, and Pinterest. Social media PLNs include such social media sites as Twitter and Facebook. EdCamp, an outgrowth of Twitter chats, combines independent learning and PLNs with formal professional development, which when combined have been found to be highly effective for technology integration (Jones & Dexter, 2014).

The reasons for the success of PLNs are numerous. For example, PLNs offer immediate feedback, support, and content, technical and pedagogical knowledge to participants (Ross et al., 2015). Ross et al. (2015) also found that when teachers are actively engaged in their PLN, there are a vast amount of resources they can tap into in a short period of time. As the people who participate in independent learning tend to be more technology savvy, it would stand to reason that these teachers would also be willing to integrate technology in their classrooms. They are also more likely to integrate technology because of the support they receive from their PLN (Holland, 2001).

However, there are also drawbacks to independent professional development. Four to ten percent of members in online communities produce more than 50—80% of the messages and resources shared, whereas the others remain inactive (Ling, Beenen, & Ludford, 2005). Similar to the drawbacks noted for informal professional development, if people are afraid to share their knowledge or are uncertain of their knowledge, they will most likely not participate in independent professional development or develop a PLN either (Ardichvili, Page, & Wentling, 2003; Wasko & Faraj, 2000).

Regardless, "the melding of social media, professional development, and professional learning networks are expanding the way educators acquire information as they move from "a 'one-size-fits-all, sit-and-get professional development'" (Killion, 2011, p. 4). Additionally, 90 percent of educators indicate they are likely to use Twitter for professional development in the next six months and 69 percent indicated they would use Twitter for professional learning over the next year (Ross et al., 2015).

Summary

Effective professional development is about removing barriers and changing teacher beliefs for successful instructional technology integration (Beach, 2012; Hiebert & Others, 1996; Levin & Wadmany, 2008). Effective instructional technology professional development can be delivered in one of three forms: formal professional development, informal professional development, and independent professional development. As Beach (2012) posits, part of the increasing effectiveness of professional development is to, "grow the teaching of digital literacies by capitalizing on the affordances of digital tools and social networking capabilities to collaborate, plan with, and learn from other teachers" (p. 256). In the next section, leadership actions to support teacher professional development and the integration of technology are examined. "District leaders should consider how altogether their leadership practices combine to facilitate a range of supports for formal, informal, and independent teacher learning activities" (Jones & Dexter, 2014, p. 382).

Leadership

Principal leadership is widely accepted as important to school effectiveness and the integration of instructional technology (Anderson & Dexter, 2005; Chang et al., 2008). In fact, the U.S. Department of Education (2016) has found that taking full advantage of technology to transform learning requires strong leadership, and school leadership is second only to classroom teaching as an influence on pupil learning (Beytekin, 2014; Leithwood, Harris, & Hopkins, 2008).

Leadership has also been shown to have great impact on the outcome of one-to-one initiatives (Anderson et al., 2000). While at the same time, one-to-one computing environments have created an evolution of sorts in the role of the principal (Dexter, 2011). The primary

leadership actions of the principal identified in this research will be the actions related to professional development and the actions that influence instructional technology integration.

Leadership Traits/Trust. A variety of traits have been found to be instrumental for effective school leadership as well as effective instructional technology integration by teachers. Leithwood, Harris, and Hopkins (2008) found that a small handful of traits explain a high proportion of the variation in leadership effectiveness; and these traits are: self-confidence, open mindedness, flexibility, persistence, resilience, and optimism. Faculty look for principals who are supportive and egalitarian, and who are genuinely concerned for their well-being (Tschannen-Moran & Gareis, 2015). In a study, when teachers were asked what they were looking for in an effective principal, they stated they are looking for principals who are approachable and open in their attitudes as they engage with teachers about instruction (Tschannen-Moran & Gareis, 2015). This trait of openness is directly related to trust, and in the literature, it the most mentioned trait of an effective leader (Price, 2012; Tschannen-Moran, 2014).

Trust is at the core of effective leadership. Trust is based on the perception teachers hold about their principal, and there are five main characteristics of trustworthy leaders: competence, consistency and reliability, openness, respect, and integrity (Bono, Hooper, & Yoon, 2012). The added impression that the principal is benevolent, honest, and open, also contribute to the trust the faculty places in its principal (Handford & Leithwood, 2013). Additionally, communication builds and solidifies trust, and trust in turn builds greater communication, which engenders professionalism for innovation (Lawson et al., 2017). Once the principal establishes trust, they are then able to capitalize on this and build capacity for continued reforms (Youngs & King, 2002). If teachers trust their leaders, it would reason they would be willing to participate in professional

development and be willing to attempt integration more than teachers who do not have trust in their principal.

Principal actions that support technology integration. To encourage teachers to integrate instructional technology, a leader needs to act. To foster a culture where teachers want to integrate instructional technology in their classrooms and see a reason for doing so, leaders of technology need to provide a vision, address barriers and beliefs, set expectations, model the use of technology, and provide support in terms of resources and professional development (Afshari et al., 2012; Chang, 2012; Ertmer et al., 2002; Jones & Dexter, 2014; Reeves, 2004). Those principals who can incorporate each, or most of these actions, and provide the motivation, commitment and proper working conditions will engender the greatest willingness to change and integrate instructional technology (Leithwood et al., 2008).

Stating and reaffirming the technology vision is central to getting buy-in from teachers and thus, their willingness to integrate technology (Networking, 2004). Principals, need to clearly articulate and implement the technology vision and plan for their schools (Chang, 2012). Machado and Chung (2015), found that the most effective principals were those, "who created a school vision for effective technology integration and provided teachers with on-going supportive professional development" (p. 44). Thus, if principals make clear the technology vision for their schools, they will then be able to articulate expectations for use and ensure teachers have the opportunity to learn, collaborate, and provide input to the leadership team (Dexter, 2011).

Clear expectations from the principal indicate to teachers the importance of instructional technology integration that allows them to better understand the vision and meet these expectations. Yuen and Ma (2008) found that when principals made clear their desire to see technology implemented in the classroom, teachers changed their perceptions of what was

expected of them and were more likely to integrate technology in their lessons. In another study, Vavasseur and MacGregor (2008) found that in schools where the principal applied more pressure while at the same time providing praise for attempting to utilize technology in their lessons, teachers created higher quality unit plans and they also understood their role in implementing a technology infused curriculum. Further, research by Pierce and Ball (2009), found that once teachers perceived that their school leader expected them to use technology, there was a change in their beliefs and they recognized the potential benefits of using technology in the classroom.

Principals are also responsible for changing teachers' beliefs, as well as the removal of barriers to integration. To facilitate the removal of these barriers, it has been suggested that leaders pair teachers who have positive beliefs about technology with those who have negative beliefs about instructional technology integration (Butler-Pascoe & Wiburg, 2003). Furthering this thought, Venkatesh, Morris, Davis, and Davis (2003) report the importance of understanding the stages of social influence in order to understand changes in belief structure. If principals understand the social networks in their buildings, they will be better positioned to facilitate changes in teacher beliefs (Daly, 2015).

Often, if one is to lead, one must lead by example. When it comes to leading for technology integration, modeling the use of technology helps teachers change their beliefs and demonstrates to them the expectation for integration (Ely, 1999). If principals are to be effective modelers for the use of technology, they should be familiar with current research and best practices in instructional technology (Afshari et al., 2012). When a principal knows how to model technology use, they begin to understand the importance the role professional development plays for those attempting to use technology (Bailey, 1997).

Additionally, good leaders seek professional development opportunities for their teachers, encourage them to attend professional development, and participate in professional development alongside them (U.S. Department of Education, 2016). Fifty-six percent of leaders cited professional development as the top challenge they needed to address for effective use of technology in the classroom (Networking, 2004). Therefore, not only is it the responsibility of the principal to learn about technology themselves, but they must also ensure others are fed with the knowledge they will need to be successful in the classroom (Anderson & Dexter, 2005). One of the respondents in a study by Villano (2008) stated, "I see success when professional development is taken seriously by administrators" (p. 41). Unfortunately, even though principals place a high value on the use of technology in the classroom, very few provide adequate training or support for their teachers to be successful (Machado & Chung, 2015).

The role of the principal does not end at encouraging teachers to attend professional development, however. They must also evaluate teachers, looking for effective instructional technology integration in their classrooms and continue to provide support, encouragement, and additional professional development when necessary (Chang et al., 2008).

Leadership theory has evolved over the decades from trait theory, behavior styles theory, situational theory, and transformational theory to a new leadership paradigm (Chang et al., 2008). In addition to these theories, instructional leadership posits that the role of the principal is to focus on changing teacher practices and thereby increasing student achievement (May & Supovitz, 2011).

Instructional and Transformational Leadership. The theory of instructional leadership grew out of the Effective Schools Movement of the 1980s. In this model, the principal is seen as

the primary source of educational expertise, whose role is to maintain high expectations for teachers and students, supervise classroom instruction, coordinate the school's curriculum, and monitor student progress (Barth, 1986). The widespread belief of instructional leadership is that the principal's involvement is necessary for any curricular change to occur (Elmore, 2000). This involvement has traditionally been thought of as being effective in both supervision and curriculum development (Marks & Printy, 2003).

The goal of instructional leadership is to change the mindsets of staff in order to create change in instructional practices (Chang, 2012). Technology integration requires a change in pedagogy and requires instructional leaders to have an understanding of technology as an instructional tool (Marks & Printy, 2003; Shuldman, 2004). On the other hand, instructional leadership can, in and of itself, be transformational (Marks & Printy, 2003).

Transformational leadership was first defined by Burns (1978) in his book, *Leadership.* In his book, he describes transformational leadership in terms of how leaders and followers interact, and the outcomes they desire collectively. This theory has been modified and expanded since the writing of this book. Transformational leadership provides intellectual direction and aims at innovating within the organization, while empowering and supporting teachers as partners in decision making (Leithwood, 1994). While Franciosi (2012) said transformational leadership, "is characterized by a focus on the concerns and needs of followers to develop them into semi-autonomous entities that can act to advance the goals of an organization without the need of constant direction" (p. 238).

Transformational leaders practice a form of democracy in their leadership style and this allows for organizations to be more nimble and to adapt to change more quickly (Franciosi, 2012).

This is necessary when it comes to leading technology, as change is constant and rapid (Afshari et al., 2012). Leaders of technology see technology as the tool for transforming teaching and learning (Bailey, 1997). In a study by Hayes and Greaves (2013), they report that in the successful one-to-one implementations they have observed, transformational leadership works best. Specifically, the transformational leadership actions of communicating and explaining the vision, giving employees a context for their work, and allowing teachers input into the process work best for one-to-one implementations. It was found that transformational leadership provides for teacher time to plan and collaborate on a regular basis, time for teachers to be part of the development of the vision, and allowed for input of the professional development offered and attended.

Thus, it is a combination of instructional and transformational leadership that creates the environment for changes to pedagogy, instructional outcomes, and overall student achievement (Marks & Printy, 2003). When principals practice both instructional and transformational leadership, they exhibit to staff that integrating technology is important to the organization and important to student learning (Afshari et al., 2012). Combined, these frameworks for leadership are components of effective digital leadership (Figure 3).

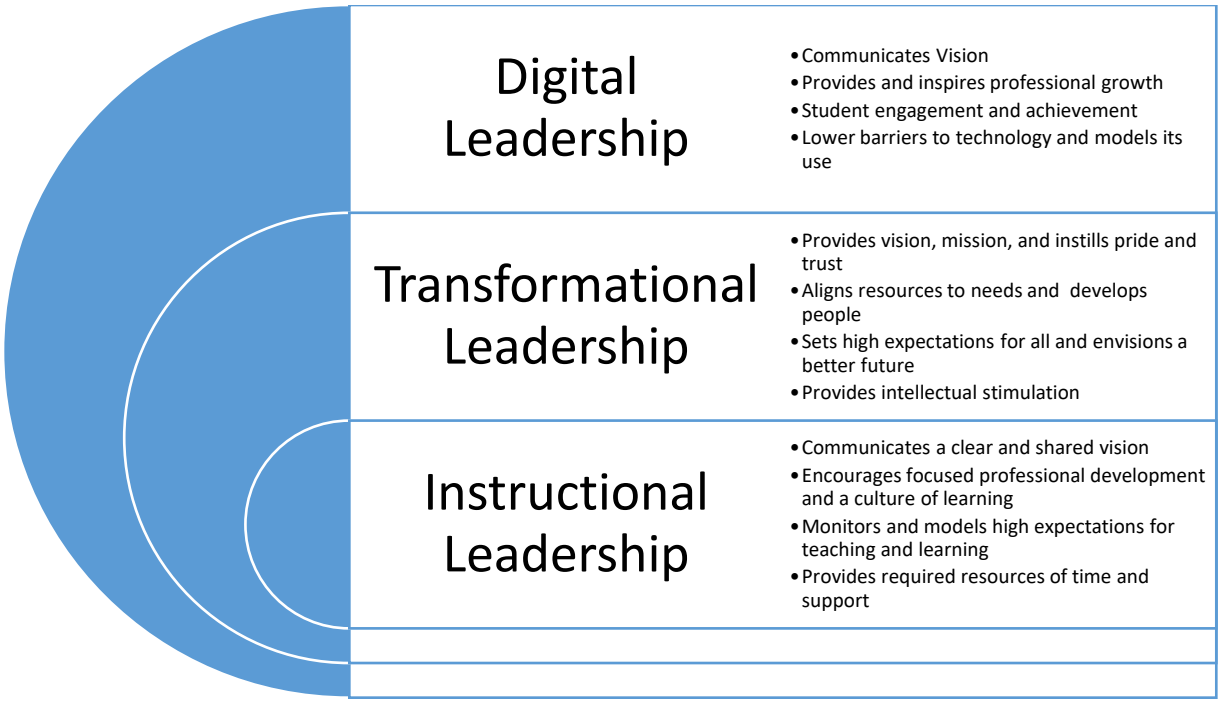

Figure 3. Instructional/Transformational/Digital Leadership

Digital Leadership. Digital leadership, also known as technological leadership, is a relatively new form of leadership and focuses on developing, guiding, managing, and applying technology and staff to different organizational operations for improved organizational performance (Chang, 2012). In a study by Ertmer, Bai, Dong, Khalil, Park, and Wang (2002), the researchers stated that administrators should, "view digital leadership as a shared responsibility requiring both administrative as well as technological skill" (p. 2). However, digital leadership is about change, and the required leadership is no different than leadership of any other change process (Sheninger, 2014). Thus, digital leadership requires leading for change.

Fullan's (2008), *Six Secrets of Change* is the forerunner to Sheninger's (2014) *Digital Leadership*. Sheninger (2014), described what digital leaders need to do to create change as: "being connected, having a vision, articulating the value, providing support, participating in

professional development, and embracing/changing beliefs and removing barriers" (Sheninger, 2014, pp. 65–67). Additionally, Chang, Chin and Hsu (2008) identified both interpersonal skills and communication skills as important digital leadership actions, prior to the work of Sheninger.

In total, the actions of the digital leader are not much different from the basic actions of leadership described above. The digital leader needs to lay out a clear vision, encourage, support and provide professional development, lower barriers and change beliefs about the benefits of instructional technology, provide appropriate monetary resources and time, promote and create a culture of collaboration, model technology use, and provide support for curricular changes, including changes to the curriculum and instructional practice in order to facilitate the integration of instructional technology (Chang et al., 2008; S. L. Dexter, Anderson, & Ronnkvist, 2002; Frank et al., 2004; Glazer et al., 2005; M. Golden, 2004; O'Dwyer et al., 2005; U.S. Department of Education, 2016). Anderson and Dexter (2000), combined these actions into six categories: strategic planning and goal setting, budgeting and spending, organization, curriculum, evaluation, and external relations (p. 2). While Chang (2012) combined these actions into five technology leadership areas: vision, planning, and management, staff development and training, technological and infrastructure support, evaluation and research, and interpersonal and communication support (p. 329). The study in this paper will examine specific leadership actions described from each of the aforementioned studies.

Digital Leadership – Vision. All leaders need to have vision to lead organizations. The overall purpose of a strong and robust vision in terms of digital leadership is to transform learning and empower students (McLeod, 2015). The most successful visions are shared visions developed by many stakeholders and those which are communicated clearly and frequently (ISTE, 2009; McLeod, 2015). Unfortunately, the result when the vision is not clear, and when stakeholders are

not part of the process, is that educators may not change their practice (Schrum & Levin, 2013). Establishing a clear vision is essential to determining what types of professional development are needed to help realize the stated vision.

Digital Leadership – PD. The actions of the digital leader in terms of professional development take various forms. Digital leaders understand the importance of professional development, and provide time for teachers to participate in professional development both inside and outside of the school day (Hayes & Greaves, 2013; ISTE, 2009). Digital leaders also take every opportunity to participate as equals in professional development with their teachers (Gerard, Bowyer, & Linn, 2010; ISTE, 2009). Digital leaders take the time to seek and deliver meaningful and effective professional development, conducted either by themselves or by staff members (ISTE, 2009; U.S. Department of Education, 2016). Finally, digital leaders encourage teachers to attend specific professional development opportunities in order to gain insights into new skills or to change beliefs (ISTE, 2009; O'Dwyer et al., 2005). Providing professional development is one form of support provided by the principal, but there are other forms of support required from the principal as well.

Digital Leadership – Support. Digital leaders, provide various forms of support and encouragement to create an environment where teachers can successfully integrate technology in the classroom (Chang, 2012; Rogers, 2000b). Digital leaders support and encourage teachers who are innovative in the use of technology and who are willing to model their practice for other teachers (Keengwe & Onchwari, 2009). Successful digital leaders provide guidance on technology tools that assist the learning process as well as those that are respectful of teachers' time (Keengwe & Onchwari, 2009). Digital leaders provide encouragement to teachers who take risks and are willing to modify their curriculum (Lu & Overbaugh, 2009). Finally, digital leaders provide

support by advocating for a technology integration coach who can work with teachers both inside and outside of their classrooms (Kennewell, Parkinson, & Tanner, 2002). Collectively, these supports tell the teacher that their principal cares about them and the purposefulness of their work. It also sends a message that the principal advocates for integrating instructional technology and that it is important for the success of the one-to-one initiative and student achievement.

One of the most efficient ways a digital leader supports integration is through modeling (ISTE, 2009). Through modeling, the principal demonstrates how to integrate the technology as well as creates the opportunity for discussion among staff about successful implementation (Keengwe & Onchwari, 2009). Another simple way leaders can provide support is by removing the management of the devices in the one-to-one classrooms from the classroom teacher so they can focus solely on integration within their curricular area (Dunleavy et al., 2007). The purpose of leadership support is to lower the perceived barriers to the integration of technology in the one-to-one classroom.

Digital leadership – Barriers and their removal. Many staff members believe there are barriers to integrating technology and still others hold strong beliefs against the value of technology. These barriers are strongly tied to the barriers for instructional technology integration described earlier in this chapter. Similarly, the greatest of these barriers is time; time to plan, time to attend professional development, and time to collaborate (K. Dawson, 2012; Duran et al., 2009; Lu & Overbaugh, 2009; Pritchett et al., 2013). In a study by Schrum and Levin (2013), teachers mentioned their appreciation for leaders who schedule time for common planning periods and content teams. Additionally, Keengwe and Onchwari (2009), found that leaders need to be committed to providing time and trainings with technology during the school day. While Holland (2001) states, “teachers need time to develop a shared discourse about what technology integration

in the curriculum looks like" (p. 263). This time for collaboration can extend outside of the school day so teachers will be able to collaborate with colleagues from other districts as well as time for collaboration between teachers in the same school in order to collaborate on student projects (Keengwe & Onchwari, 2009).

A second barrier a digital leader can lower is the need for teachers to ask for money to purchase resources (U.S. Department of Education, 2016). While developing budgets, leaders need to understand where to place the dollars to ensure technology purchases will be implemented in the classroom (Spires et al., 2012). Additionally, digital leaders allocate funds for professional development, technology integration staffing, as well as funds for release time for teachers to attend professional development, plan lessons that integrate technology, and collaborate with colleagues to share best practices (Holland, 2001; Hur & Oh, 2012). Dexter, Anderson, and Roonkvist (2002) state, "If technology leaders want teachers to design instruction that utilizes educational technology, ……. then their workplace should provide convenient access to educational technology resources and unfailing support for their use" (p. 279).

Additional barriers include culture, prevailing teacher attitudes and beliefs, and minimizing the number of changes happening at the same time (Ertmer, 1999; Hew & Brush, 2007; Zhao & Frank, 2003). It is the role of the digital leader to lower these barriers by assuaging fears and changing strongly held beliefs (Gerard et al., 2010; Holland, 2001). Once of the best ways for principals to nudge teachers to overcome their negative beliefs is for the principal to demonstrate enthusiasm and support for instructional technology and the teachers who successfully implement it in their classrooms (Holland, 2001).

Principal leadership makes a difference in the level of integration in the classroom and principals who understand the role of technology and its effect on student achievement are better

positioned to lead in a one-to-one environment (M. Golden, 2004; Hallinger & Heck, 1996). Yet, just as effective digital leadership can yield increased integration of technology, detrimental digital leadership such as micromanaging teachers, creating a restrictive infrastructure, lacking a clear vision, and holding teachers accountable for technology integration they do not know, or have not yet experienced, can hinder, or even halt the integration of instructional technology in the classroom (Spires et al., 2012). Bailey (1997) writes, "technology integration is one of the toughest issues facing administrators" (p. 60).

Summary

One-to-one computing environments require teachers to change the way they both think about technology and the way they integrate the technology into the curriculum (Lumpe & Chambers, 2001; Spires et al., 2012). Principals are instructional leaders who work with teachers to oversee the curriculum for improved academic performance by students (May & Supovitz, 2011). Principals are also transformational leaders who work with all members of the school community to attain the goals of the school and the community (Franciosi, 2012; Spires et al., 2012). Finally, the principal's digital leadership can been strongly correlated to teachers' integration of instructional technology and has also been found to be paramount to the current needs of public education (Chang et al., 2008).

Literature Review Summary

This chapter was written in four parts. The first section discussed one-to-one computing and discussed the varying fidelity of implementation of these initiatives. Although there is evidence that despite the large sums of money being spent on one-to-one initiatives, there remains a large chasm in the integration of these devices in the curriculum (Cuban, 2001). This study seeks

to add to the existing literature on one-to-one computing by outlining how technology integration, professional development, and leadership actions affect successful instructional technology integration in the one-to-one classroom (Abell Foundation, 2008).

The second section of this chapter outlined the need for technology integration in the one-to-one classroom. Technology integration was examined through the TPACK framework, focusing on the need to build teacher capacities in technology, pedagogy, and content in order to create the conditions of effective instructional technology integration (Mishra & Koehler, 2006). This study will add to the literature of Chang (2012), by examining actions the principal takes to increase instructional technology integration. Additionally, this research will add to the work of Lawless and Pellegrino (2007) and examine the type of professional development taken by a teacher and the likelihood of that teacher integrating their learning into the one-to-one classroom.

The third section examined professional development for instructional technology integration. This research extends the work of Jones and Dexter (2014) who defined formal, informal, and independent professional development. Although Jones and Dexter (2014) described the three forms of professional development, this study seeks to specifically identify in which forms teachers participate more frequently and correlate the forms to the type of instructional integration occurring in the classroom after having participated in each type.

The fourth section examined general leadership actions, instructional leadership, transformational leadership, and digital leadership. Digital leaders have an effect on teacher professional development and the integration of technology in the one-to-one classroom (Chang, 2012; Hayes & Greaves, 2013). This research extends the work of Sheninger's (2014) digital leadership in that the actions of the principal are correlated to both the willingness of teachers to

participate in each of the three forms of professional development as well as a teacher's willingness to integrate instructional technology in the one-to-one classroom.

Finally, a teacher's willingness to participate in professional development, their willingness to integrate instructional technology in their classrooms, and their perception of their leader's effectiveness are dependent on their personal beliefs and the barriers imposed. Although there is ample research about teacher beliefs and barriers to technology in instruction, very little has been correlated to the one-to-one classroom. This study seeks to identify if previous beliefs and barriers found in the literature by Levin and Wadmany (2008) and Ertmer (2005) hold true for teachers working in one-to-one environments.

The next chapter focuses on the methodology utilized in this study including the research design, sampling procedures, instrumentation, data collection, data analysis, and researcher bias and validity.

Chapter 3:
Methodology

Introduction

This chapter will outline the research design, instrumentation, data collection, and data analysis that will be used in this study. One-to-one computing environments provide unique challenges for teachers (Downes & Bishop, 2015) and the research demonstrates the need for professional development to offset the deficiencies in teachers being able to implement instructional technology in their lessons (Golden, 2004; Scott & Mouza, 2007). In particular, professional development that helps teachers to become more student centered has been the goal of many professional development offerings for one-to-one classrooms (K. Dawson et al., 2008; Penuel, 2006). In one-to-one classrooms, the goal is for teachers to integrate technology for the purpose of increased student achievement (Penuel, 2006). Garthwait & Weller (2005), state that just having technology in the classroom does not ensure integration or changes in teachers' technology or pedagogy. Thus, this study will be examined through the technology, pedagogy, and content knowledge (TPACK) framework which describes an ideal intersection of these three disciplines for effective technology integration (Mishra & Koehler, 2006).

The leadership role of the principal is multifaceted with regard to supporting teacher implementation of various instructional strategies. Previous research also indicates that principals can play a significant role in helping teachers integrate technology successfully (Anderson & Dexter, 2005; Chang et al., 2008). Additionally, principals are instrumental in providing the support for teachers participation in instructional technology professional development and assist them in personalizing learning their classrooms (U.S. Department of Education, 2016). While at the same time, principals are responsible for helping teachers overcome their own personal biases

(Ertmer, 2005) and the barriers that impede them from participating in instructional technology professional development and thus also impede them from integrating technology into their instruction (Machado & Chung, 2015). Through the lens of digital leadership, this study will examine the leadership actions of principals and how these actions affect teacher participation in instructional technology professional development, their ability to mitigate teacher biases and barriers and how their actions impact instructional technology integration in their one-to-one classroom (Sheninger, 2014).

The purpose of this study is to examine the relationship between formal, informal, and independent professional development offerings, the digital leadership actions of principals and teacher biases and barriers, and their influence on public middle school teachers' integration of instructional technology in a one-to-one environment. This quantitative, correlational design study will be examined through the conceptual framework of Digital Leadership and the Technology, Pedagogy and Content Knowledge (TPACK) framework. The population for this study will be public middle school teachers of grades five through eight teaching in a one-to-one computing environment on Long Island, New York.

Research Questions

1. Is there a relationship between the leadership actions of principals and teacher participation in instructional technology professional development?
2. Is there a relationship between professional development taken in instructional technology by teachers and the use of instructional technology integration in the middle school one-to-one classroom?

a. Does participating in formal teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?

b. Does participating in informal teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?

c. Does participating in independent teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?

3. Is there a relationship between the leadership actions of principals and the integration of instructional technology in the one-to-one classroom?

4. What are the teacher biases and barriers toward instructional technology and the integration of instructional technology in the one-to-one classroom?

The null hypothesis for this study are as follow:

H_0 = There is no relationship between principal leadership actions and teachers' willingness to participate in instructional technology professional development.

H_0 = There is no relationship between participating in formal, informal, and/or independent professional development and the level of instructional technology integration in the one-to-one classroom.

H_0 = There is no relationship between principal leadership actions and teachers' integration of instructional technology in the one-to-one classroom.

Research Design

Quantitative study design is defined by Creswell (2014, p. 247) "as a means for testing objective theories by examining the relationship among variables." This study surveyed middle

school teachers who work in schools on Long Island, New York where every student, in at least one entire grade, is provided access with their own personal technology device for learning. This study utilized a correlational design, as the purpose is to understand the relationship between instructional technology professional development type and the level of instructional technology integration in the one-to-one classroom (Creswell, 2015). The researcher hypothesized that each form of teacher professional development would increase the level of instructional technology integration in the one-to one-classroom. The study also examined the digital leadership actions of principals and whether these actions promoted and encouraged teacher participation in instructional technology professional development, furthering instructional technology integration in the classroom.

The leadership actions were examined through Sheninger's (2014) Digital Leadership theory which posits the importance of a leader's role in encouraging teachers to integrate technology by creating a vision, exploring the value of technology and embracing it, supporting teachers with resources and time, communicating the positives of technology loudly and frequently, and lastly, providing and supporting low-cost, high quality professional development. The role of the principal in regard to changing teacher beliefs and attitudes has been well documented (Holland, 2001). The goal for the principal is to reduce and/or remove the first and second order barriers teachers face while attempting to integrate instructional technology (Ertmer, 1999). The researcher hypothesized that certain leadership actions taken by principals would be reported as significantly impacting professional development and technology integration more than others.

Instructional technology integration was examined through the technology, pedagogy, and content knowledge (TPACK) framework (Mishra & Koehler, 2006). Through the intersection of

content, technology, and pedagogy, it was hypothesized that true technology integration is possible (Koehler & Mishra, 2009). To this end, teachers' beliefs about instructional technology and the perceived barriers to integrating this technology was examined in this study related to their desire to participate in instructional technology professional development for the purpose of technology integration. When teachers take their content knowledge and extend it to the appropriate pedagogical methods, increased student understanding and learning are the outcome (Shulman, 1987). Additionally, when teachers intersect this content and pedagogical knowledge with instructional technology knowledge instructional technology integration can be successful in their classroom (Mishra & Koehler, 2006). Finally, the researcher examined that certain teacher beliefs and accompanying barriers will not only affect technology integration, but also determine whether a teacher will participate in any professional development related to instructional technology or integrate instructional technology in their one-to-one classroom.

Survey design was utilized for this study as it will allow the researcher to quantitatively describe relationships, trends, attitudes, and opinions of a population by studying a sample of that population (Creswell, 2015, p. 249). The researcher delivered the survey instrument in electronic form, from the researcher to the building principal who then sent the link for the study to their teachers who work in one-to-one classrooms throughout the day. The survey instrument was generated from references to questions from the Level of Technology Integration Survey (LoTI) survey (Moersch, 1995) and a survey from a doctoral dissertation created by Nolasco (2009).

Population Procedures

The population surveyed in this study were middle school teachers from public school districts located in Nassau and Suffolk counties, New York, who have implemented a one-to-one initiative in at least one grade level. The middle school population was chosen because the middle

school philosophy includes the principles of collaboration, relationship building, developing an engaging curriculum, and individualized instruction. These are also principles upon which one-to-one environments have been built (Downes & Bishop, 2015). Middle schools, as defined by the New York State Department of Education, are schools with grades five to seven, five to eight, or six to eight (NYSED, 2015c).

Long Island, New York contains the counties of Kings, Queens, Nassau and Suffolk (New York, 2016) . For the purposes of this study, only the counties of Nassau and Suffolk were included as Kings and Queens County are part of the large city school system of New York City (NYSED, 2015c). Kings and Queens counties were excluded from this study because the funding for technology and teacher professional development comes from the City of New York's overall budget as well as private donations versus the individual local school budgets in Nassau and Suffolk Counties, and because the instructional leadership responsibilities of the principals in New York City vary from those in Nassau and Suffolk Counties (Casserly, Jepson, Williams, Lewis, & Council of the Great City Schools DC., 2000; Golden, 1997).

Within this region there are 56 public school districts in Nassau County and 69 in Suffolk County (NYSED, 2015a). Of these 125 districts, some are K-6, some are K-8, some are 7-12, and some are K-12 (NYSED, 2015a). This unique region of New York State contains districts of varying needs, populations, socioeconomic status, and migrant populations (NYSED, 2015a, 2016c). The region serves students of all ethnicities as well as a large number of English language learners (NYSED, 2015a). Its close proximity to New York City allows for immigrants to move into the region for its perceived educational opportunities as well as its lower cost of living when compared to New York City. Per pupil expenditure in the area ranges from $69,665 per pupil to $19,796 per pupil (NYSED, 2015a).

Considering the aforementioned characteristics, this area represented a fair sampling as a representative region of New York State. The demographic comparisons between this region and New York State as a whole are identified in Table 3 (NYSED, 2015a). The data in the Table 3 below includes New York City, Buffalo, Rochester, Syracuse, and Yonkers which are urban centers, and due to their large size and greater diversity, the State average may be higher for certain subgroups in the overall State percentages.

Table 3

New York State vs. Nassau/Suffolk Demographic Data

Demographic	**State**	**Nassau**	**Suffolk**	**Nassau/Suffolk Average**
Total Students	2,649,039	200,760	242,180	221,470
Male	51%	51%	51%	51%
Female	49%	49%	49%	49%
White	45%	52%	60%	56%
Hispanic	25%	22%	25%	23.5%
Asian	9%	12%	4%	8%
Am. Ind.	1%	0%	0%	0%
Black	18%	13%	8%	10.5%
Multi	2%	1%	2%	1.5%
ENL	8%	7%	7%	7%
SWD	17%	12%	14%	13%
FRPL	54%	28%	36%	32%

Many averages of demographic characteristics in these two counties are similar to those of New York State, including gender, race, English language learners, and students with disabilities.

However, the socioeconomic status of this region is considerably wealthier than the rest of the State (NYSED, 2015a). After considering fiscal and program resources, many districts in this region have the resources to implement one-to-one initiatives and several have already completed this implementation. Although this factor creates a greater percentage of schools with one-to-one

environments than other parts of the State, the passage of the Smart Schools Bond Act (SSBA) and the computer based testing requirement from the New York State Education Department will create the impetus for more districts across the State to consider implementing one-to-one environments (NYSED, 2015b, 2016a).

Sampling Method

This study used cluster sampling (Creswell, 2015; Vogt, Gardner, & Haeffele, 2012). There are 127 Long Island middle school principals and 125 district technology directors on Long Island, and these individuals were first surveyed through their respective listservs and asked whether they had a one-to-one environment in at least one grade in the middle schools in their districts (Table 4). From this survey, 64 districts responded to the survey, and of those, 30 responded that at least one grade in their district's middle school had a one-to-one program. Upon further examination, it was noted that four of the 30 responding districts were either K-6 districts or 7-12 districts with no middle school as defined by NYSED (2015a).

The researcher analyzed the 26 remaining districts for county in which they are situated and need based on NYSED (2015). From this data, 12 districts were selected as test sites for this research. Thus, the population for this research were middle school teachers teaching in one of these 12 districts. The total population for this research totaled 1040 middle school teachers. Of the districts reporting at least one grade in their middle school having a one-to-one initiative (Table 4), 69 percent of the districts were from Nassau County and 31 percent were from Suffolk County. The survey was distributed to a sample that included 71 percent of the teachers from middle schools located in Nassau County and 29 percent teaching in middle schools in Suffolk County (Table 3).

Table 4

Survey of Districts on Long Island with at Least One Grade with One-to-One Devices

District Name	**County**	**Need**
District A	Nassau	Low
District B	Nassau	Low
District C	Suffolk	Low
District D	Nassau	Average
District E	Nassau	Low
District F	Nassau	Average
District G	Suffolk	Average
District H	Nassau	Low
District I	Nassau	Low
District J	Suffolk	Low
District K	Suffolk	Average
District L	Suffolk	Low
District M	Suffolk	Low
District N	Nassau	Average
District O	Nassau	Low
District P	Nassau	Average
District Q	Suffolk	Average
District R	Nassau	Average
District S	Nassau	Low
District T	Nassau	Average
District U	Nassau	Low
District V	Nassau	Low
District W	Nassau	Low
District X	Nassau	Low
District Y	Suffolk	Low
District Z	Nassau	Low

Additionally, 34 percent of the districts in Table 4 were of average need and 66 percent were of low need. Of the teachers surveyed, 33 percent are teaching in average need districts and 67 percent are teaching in low need districts (Table 5).

Table 5

Districts Used in Sample and Total Teachers Surveyed by District

District Name	County	Need	# Teachers
District A	Nassau	Low	**80**
District B	Nassau	Low	**41**
District C	Suffolk	Low	**10**
District D	Nassau	Average	**130**
District E	Nassau	Low	**184**
District F	Nassau	Average	**96**
District G	Suffolk	Average	**71**
District H	Nassau	Low	**111**
District I	Nassau	Low	**98**
District J	Suffolk	Low	**70**
District K	Suffolk	Average	**93**
District L	Suffolk	Low	**56**
Total Teachers Surveyed			**1040**

The survey instrument was developed using Survey Monkey and is attached as Appendix D. Survey Monkey is a web based tool (surveymonkey.com) whose purpose is to create the survey, deliver the survey, and collect the data in a meaningful way such that the data can be analyzed with appropriate statistical analysis software. The survey was distributed electronically and the researcher arranged for the participants at each location to respond to the survey through the building principal via email. The survey was distributed to 1040 teachers. Of this sample, 383 (37%) of the teachers completed the demographic questions of the survey, 285 (27%) of the teachers completed the professional development section of the survey, and 263 (25%) of the teachers completed the survey in its entirety (leadership, barriers and beliefs). Participant were informed the survey would take approximately 20 minutes to complete and that all answers would be confidential. All respondents were given the option to not participate if they so desired.

Instrumentation

The survey instrument used for this study is a researcher developed instrument in cooperation with Sage research professors. The 20 item survey was constructed referencing the LoTI Digital Age Survey (Moersch, 1995), as well as survey questions reported in a dissertation by Nolasco (2009). The frameworks from the LoTi survey and the Nolasco (2009) survey were used as constructs for the researcher developed survey instrument. The LoTi survey was used to measure the level of technology integration by teachers and asks respondents about specific barriers to using technology as well as biases toward technology (Moersch, 1995). The survey was developed in 1995 and has since been updated on a regular basis and is currently owned and maintained by LoTi Connection (loticonnection.com). The Nolasco's (2009), survey, asked teachers about the leadership behaviors of principals in relation to technology in middle schools. Questions included demographic questions, questions about instructional technology professional development, questions about the leadership actions of principals, questions about instructional technology integration, and questions concerning teacher beliefs about instructional technology and the perceived barriers to integrating instructional technology (Appendix D).

The survey questions concerning professional development were created by the researcher using the frameworks of instructional technology professional development outlined by Jones & Dexter (2014). The professional development questions ask teachers about the instructional technology professional development they have participated in over the previous twelve months, as well as if the professional development was utilized by the teacher for the integration of instructional technology in the one-to-one classroom. The questions concerning instructional technology professional development focused on formal, informal, and independent professional development. The matrix for the professional development questions were developed by the

researcher and are based on the literature on effective professional development for technology integration (Beach, 2012; Garet et al., 2001; McLeod, 2015; Mouza, 2006). The questions about the leadership actions of principals ask teachers to identify the actions that principals use to encourage teachers to participate in instructional technology professional development and whether these actions caused them to integrate instructional technology in their one-to-one classroom.

The survey instrument was piloted with a group of twelve high school teachers working in the field of education, all of whom have had one-to-one classroom experience within the last five years, to ensure the questions are asking what the researcher intends (Lewis-Beck, Bryman, & Liao, 2004). Based on recommendations from this pilot group, the survey was refined to include suggested edits. This established construct and content validity (Muijs, 2004). Validity was established in that each of the questions were analyzed for clarity and unambiguity (Muijs, 2004, p. 74).

Table 6

Survey Question by Topic

Survey Question Number	Topic	Response Type
Questions 2-6	Demographic	Forced Choice
Questions 7, 10, 13	Number of times participated in formal, informal, and independent professional development	Forced Choice
Questions 8, 9, 11, 12, 14, 15	Technology integration actions	Yes/No/Not Applicable
Question 16	Leadership actions for instructional technology integration	Yes/No/Not Applicable

Question 17	Leadership actions for participation in professional development	Yes/No/Not Applicable
Question 18	Perceived barriers to integration	5 Point Likert
Questions 19	Beliefs about instructional technology	5 Point Likert
Question 20	Beliefs about one-to-one initiatives	5 Point Likert

After establishing validity, the survey was created in Survey Monkey ("Survey Monkey," 2016) and distributed to teachers in the 12 identified middle schools identified in Table 5. The instrument was a 20 question survey with questions two to six being forced choice (Vogt et al., 2012) asking respondents to identify various demographic factors such as gender, teaching assignment, years of classroom experience, free and reduced lunch percentage at the school, and total student enrollment. Questions seven, ten, and thirteen asked respondents to indicate the number of times they participated in formal, informal, and independent instructional technology professional development respectively. Questions eight, nine, eleven, twelve, fourteen, and fifteen asked respondents if after having taken one of the three forms of professional development, whether their instructional technology practice changed by answering yes, no, or not applicable. Question 16 gave respondents a list of leadership actions and respondents were asked whether these actions encouraged them to integrate instructional technology in their one-to-one classroom by responding yes, no, or not applicable. Question 17 gave respondents another list of leadership actions and asked respondents if these actions encouraged them to participate in instructional technology professional development, once again by answering yes, no, or not applicable. Question 18 asked teachers to report the barriers they perceived as hindering their ability to integrate instructional technology in their classroom (Hixon & Buckenmeyer, 2009) through

forced choice response. Questions 19 and 20 asked respondents to state their level agreement on a five-point Likert scale (Vogt et al., 2012) to a series of statements concerning instructional technology and one-to-one technology as the research indicates teacher beliefs have a large influence on both teacher willingness to participate in instructional technology professional development as well as integration of instructional technology (Table 6) (Lumpe & Chambers, 2001).

Data Collection

The cross-sectional survey (Muijs, 2004) was distributed electronically to 1040 teachers working at the 12 selected districts. The 12 districts were quota selected (Muijs, 2004). Quota sampling is a non-probability version of stratified sampling. For this study, the percentage of schools selected from Nassau and Suffolk counties were in proportion to the total number of schools in Nassau and Suffolk county reporting having a one-to-one initiative in at least one grade in their middle schools. The researcher sent letters to each district superintendent (Appendix B) and middle school principal (Appendix C) seeking their teachers' participation in the survey. Once approval was granted, the researcher sent the link to the survey to the middle school principal and asked them to distribute the survey via email to their staff. Principals were asked to email the researcher back with the number of teachers the email was distributed to as well as the date the survey was distributed. This process was repeated a second and third time to ensure the largest number of responses possible. All responses were collected in the Survey Monkey program and the privacy policy indicates the results are the property of the researcher and not the company ("Survey Monkey-Privacy Policy," 2016). The data held in this program was password protected with only the researcher having access.

As this study involves human subjects, all procedures set forth by the Sage College Institutional Review Board (IRB) were followed and permission to deliver the survey was first obtained from the IRB (Appendix A). By agreeing to take the survey and attesting to the procedure outlined in the introductory script to the survey, participants agreed to informed consent. At any time, participants were allowed to opt-out or refuse to participate in the survey completely. Participants were informed that all responses and data supplied would be completely anonymous. The surveys did not have any identifier as to the district or school to which a participant belongs. All responses were aggregated to ensure complete anonymity to the respondents. There were no identifiers on the front or back end of data collection and the researcher did not know who responded or in what school the respondents worked. In addition, no questions on the survey compromised the anonymity of the respondents. All data was purged from all computer programs at the conclusion of the study and a file of the data was maintained in a password protected file on the researcher's computer for the three-year minimum required by the (IRB).

Data Analysis

The survey data collected in Survey Monkey was downloaded into the statistical analysis software IBM Statistical Package for the Social Sciences (SPSS) for Windows for analysis. Descriptive statistics were first used to indicate general characteristics and tendencies in the data (Creswell, 2015). Two approaches to analysis were applied to address the research questions. The first approach utilized various descriptive statistics to create a holistic profile of the sample (Creswell, 2015). The second approach to analysis was relational to determine:

1. If a relationship exists between the leadership actions a principal in a one-to-one middle school takes and a teacher's willingness to participate in formal, informal, and independent professional development,

2. If a relationship exists between formal, informal, and independent professional development and the integration of instructional technology in the one-to-one classroom, and

3. If a relationship exists between the leadership action of principals in a one-to-one middle school how teachers integrate instructional technology after participating in each of these three forms of professional development.

Finally, consistent with the first approach to analysis, the data was analyzed descriptively by frequency of response for barriers to technology integration, and respondent beliefs about instructional technology and one-to-one environments in general.

Researcher Bias

The researcher hypothesized that a hybrid of the types of professional development will lead to the greatest integration of instructional technology in the one-to-one classroom similar to the findings of Jones & Dexter (2014). Even though many districts still support formal professional development more than informal or independent, teachers are beginning to find alternatives to district sponsored professional development (Riverin & Stacey, 2008; Ross et al., 2015). Further, because time is reported as one of the greatest barriers to the integration of instructional technology and teachers participating in professional development, the researcher hypothesized that teachers will prefer independent professional development over formal and informal professional development (Pritchett et al., 2013; Ross et al., 2015). More to this point, independent professional development allows for learning that is "just in time" (Granger et al., 2002).

The researcher also believed leadership actions have a positive correlation to participation in instructional technology professional development as well as teachers willing to integrate instructional technology in their one-to-one classroom. This belief correlated to research concerning leading organizations through change and integrating technology requires digital leadership (S. Dexter, 2011;

Sheninger, 2014). Similarly, this belief was based on existing literature concerning leadership actions to encourage participation in professional development (Parr, 1999). Finally, the researcher believed significant barriers to instructional technology integration continue to exist and that teacher beliefs correlate to barrier to instructional technology integration. These beliefs and barriers have been written about extensively by Ertmer (1999) and others. Thus, there was no reason for the researcher to believe this sample would not indicate similar barriers and beliefs. However, these researcher biases and beliefs did not interfere with the study as all questions were asked without bias and the results were collected anonymously and analyzed quantitatively without bias.

All procedures outlined in the methodology were adhered to and the selection of the target districts was selected so as to minimize and possible response bias (Creswell, 2015).

Summary

Research indicates that principal actions such as encouraging teachers to attend professional development, developing trust, learning alongside teachers, providing time to collaborate and plan with colleagues, and aligning the technology vision with student learning support successful instructional technology integration (U.S. Department of Education, 2016; Youngs & King, 2002). To date, there is no identified study that has demonstrated a relationship between formal, informal, and independent professional development and instructional technology integration. However, Jones & Dexter, (2014), found that teachers prefer a blended environment for professional development and identified the benefits and drawbacks to each in their study. Research has also demonstrated a relationship between principal actions and instructional technology integration, although available studies on their effect on integration in the one-to-one classroom is missing (Holland, 2001). There is ample evidence in the research that teacher beliefs affect both teachers' willingness to participate in professional development as well as their

willingness to integrate instructional technology in the one-to-one classroom (Lumpe & Chambers, 2001; Windschitl & Sahl, 2002). Finally, research has also indicated that when teachers experience certain barriers, they will be less likely to integrate instructional technology in their classroom (Ertmer, 1999). Again, as this relates to the one-to-one classroom research appears to be missing.

Chapter three describes the research design, the sample, instrumentation, and the data collection and analysis that will be utilized in this study. This quantitative study surveyed middle school teachers working in classrooms where every student is provided with a one-to-one device for learning. The relationships between principal actions and teacher participation in instructional technology professional development as well as instructional technology integration in the one-to-one classroom will be analyzed. The relationship between formal, informal, and independent instructional technology professional development and instructional technology integration was also investigated. Finally, the relationship between teacher biases and barriers to instructional technology integration was investigated. Twelve Long Island districts were identified based on need and county for survey administration. Participants responded to the survey through an online tool known as Survey Monkey. Survey results will be downloaded into SPSS and both descriptive and relational statistics will be used for data analysis.

Chapter 4:
Analysis

Introduction

The purpose of this study was to examine the relationship between formal, informal, and independent instructional technology professional development offerings, the leadership actions of principals and teacher biases and barriers, and their influence on public middle school teachers' integration of instructional technology in a one-to-one environment. This quantitative, correlational design study was examined through the conceptual framework of Digital Leadership and the Technology, Pedagogy and Content Knowledge (TPACK) framework. The population for this study was public middle school teachers of grades five through eight teaching in a one-to-one environment on Long Island, New York.

A survey was developed in SurveyMonkey (Survey Monkey, 2016) and administered to teachers via email, in twelve districts throughout Long Island, New York. The survey data collected in Survey Monkey was downloaded into the statistical analysis software IBM Statistical Package for the Social Sciences (SPSS) for Windows for analysis. Chapter Four analyzes the collected survey data and addresses the following research questions:

1. Is there a relationship between the leadership actions of principals and teacher participation in instructional technology professional development?
2. Is there a relationship between professional development taken in instructional technology by teachers and the use of instructional technology integration in the middle school one-to-one classroom?

    a. Does participating in formal teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?

   b. Does participating in informal teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?

   c. Does participating in independent teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?

3. Is there a relationship between the leadership actions of principals and the integration of instructional technology in the one-to-one classroom?

4. What are the teacher biases and barriers toward instructional technology and the integration of instructional technology in the one-to-one classroom?

Two approaches to analysis were applied to address the research questions. The first approach utilized various descriptive statistics to create a holistic profile of the sample (Creswell, 2015). The second approach to analysis was relational to determine three things. First, if a relationship exists between the leadership actions a principal in a one-to-one middle school takes and a teacher's willingness to participate in formal, informal, and independent professional development. Second, if a relationship exists between formal, informal, and independent professional development and the integration of instructional technology in the one-to-one classroom. Third, if a relationship exists between the leadership actions of principals in a one-to-one middle school and how teachers integrate instructional technology after participating in each of these three forms of professional development. Finally, consistent with the first approach to analysis, the data was analyzed by frequency of response related to technology integration barriers teachers experience, and their beliefs about instructional technology and one-to-one environments in general.

Descriptive Analysis of the Sample

To determine the districts that currently have a one-to-one initiative in at least one grade in their middle school, an initial survey was sent to technology directors and middle school principals through their respective listservs. This was a three-question survey and asked: name of district, does your middle school have at least one grade with one-to-one devices (device type does not matter), and district email contact (MS principal or Technology Coordinator/Director). It was found that of the districts that reported having a one-to-one initiative in at least one grade in their middle school, 34% were of average need and 66% were of low need (Table 7). From this initial survey, 12 districts with 1040 one-to-one teachers were selected. From this sample, 405 (38.94%) teacher respondents started the survey and 263 (25.29%) completed the survey through question 20. The sample for this survey was comprised of districts with 33% having average need and 67% having low need (Table 8). Additionally, the teachers who responded to this survey included 39% from average need schools and 61% from low need schools which is representative of the full population (Table 9).

Table 7

Districts Reporting at Least One Grade in Their Middle School with One-to-One Computing

District Name	County	Need	Classification
District A	Nassau	Low	Suburban
District B	Nassau	Low	Suburban
District C	Suffolk	Low	Suburban
District D	Nassau	Average	Suburban
District E	Nassau	Low	Suburban
District F	Nassau	Average	Suburban
District G	Suffolk	Average	Suburban
District H	Nassau	Low	Suburban
District I	Nassau	Low	Suburban
District J	Suffolk	Low	Suburban
District K	Suffolk	Average	Suburban
District L	Suffolk	Low	Rural

District M	Suffolk	Low	Rural
District N	Nassau	Average	Suburban
District O	Nassau	Low	Suburban
District P	Nassau	Average	Small City
District Q	Suffolk	Average	Rural
District R	Nassau	Average	Small City
District S	Nassau	Low	Suburban
District T	Nassau	Average	Suburban
District U	Nassau	Low	Suburban
District V	Nassau	Low	Suburban
District W	Nassau	Low	Suburban
District X	Nassau	Low	Suburban
District Y	Suffolk	Low	Rural
District Z	Nassau	Low	Suburban

Table 8

Districts Used for This Study

District Name	**County**	**Need**	**Classification**	**# Teachers**
District A	Nassau	Low	Suburban	**80**
District B	Nassau	Low	Suburban	**41**
District C	Suffolk	Low	Suburban	**10**
District D	Nassau	Average	Suburban	**130**
District E	Nassau	Low	Suburban	**184**
District F	Nassau	Average	Suburban	**96**
District G	Suffolk	Average	Suburban	**71**
District H	Nassau	Low	Suburban	**111**
District I	Nassau	Low	Suburban	**98**
District J	Suffolk	Low	Suburban	**70**
District K	Suffolk	Average	Suburban	**93**
District L	Suffolk	Low	Rural	**56**
Total				**1040**

Table 9

Respondents by Free and Reduced Lunch Percentage

% Free and Reduced Lunch	Responses	Percent
Less than 20% (Low Need)	229	61.4%
20% - 69% (Average Need)	144	38.6%
Greater than 70% (High Need)	0	0%
Total	**373**	**100.0%**

To take a closer look by geographic location (Table 7), it was found that 69% of the districts reporting having at least one grade in their middle school with one-to-one computing were from Nassau County and 31% were from Suffolk County. The sample for this study (Table 8) is composed of 71% of respondents from public middle schools with one-to-one initiatives located in Nassau County and 29% of the respondents from one-to-one middle schools in Suffolk County, reflecting the county parameters of the population (Table 7). The sample for this study reflected the initial population in terms of district wealth and pupil needs.

Of the 405 respondents who began the survey, 383 respondents (94.5%) answered the question pertaining to gender. Of this sample, 73% of the respondents were female, while males comprised 27% of this sample (Table 10).

Table 10

Responses by Gender

Gender	Responses	Percent
Female	279	72.8%
Male	104	27.2%
Total	**383**	**100.0%**

The respondents to this survey came from middle schools with varying numbers of students (Table 11). Respondents represented middle schools with student populations of 251-500 (26%), 501-750 (29%), and 751-1000 (26%) (Table 11).

Table 11

Student Population in School Where Respondent Works

Student Population	Responses	Percent
Less than 100	3	.8%
101-250	7	1.8%
251-500	100	26.3%
501-750	109	28.7%
751-1000	100	26.3%
1001+	61	16.1%
Total	**380**	**100.0%**

Almost half of the respondents in this sample have been in the classroom between 11 and 20 years, representing 46% of the sample. The remaining 26% have 10 years or less in the classroom, and the remaining 28% have 21 years of experience or more in the classroom (Table 12).

Table 12

Responses by Years Teaching

Years Teaching in the Classroom	Reponses	Percent
1-5 Years	48	12.5%
6-10 Years	53	13.8%
11-15 Years	76	19.8%
16-20 Years	100	26.1%
21-25 Years	58	15.1%
26-30 Years	29	7.6%
31+ Years	19	5.0%
Total	**383**	**100.0**

Respondents who completed the survey represent all disciplines with the three highest certification areas identified as: Special Education (17.4%), English Language Arts (16.1%) and Math (13.7%) teachers comprising 47.2% of the sample, with the remaining 52.8% comprising the remaining certification areas (Table 13).

Table 13

Responses by Teacher Certification

Certification	Frequency	Valid Percent
Special Education	66	17.4%
English Language Arts including AIS or in a literacy support	61	16.1%
Mathematics including AIS or in a mathematics support capacity	52	13.7%
Science	39	10.3%
Social Studies	32	8.4%
Languages Other Than English	22	5.8%
Music	16	4.2%
Family and Consumer Science	11	2.9%
Visual Arts	10	2.6%
Health	9	2.4%
English to Speakers of Other Languages	8	2.1%
Technology Education	8	2.1%
Library Media Specialist	7	1.8%
Instructional Technology (Computer Classes)	5	1.3%
Other	34	8.9%
Total	**380**	**100.0%**

Research Question 1: Is there a relationship between the leadership actions of principals and teacher participation in instructional technology professional development?

As previously noted in Chapter 2, formal professional development defined in this study are those activities that are arranged by the district, are aligned to district goals, and are held at a predetermined time and place (Jones & Dexter, 2014). Informal professional development as defined in this study, includes teachers collaborating in communities of practice (COPs), talking in informal groups (study groups) during preps, lunch, or between classes, internships, and mentoring relationships with technology proficient staff members other than the district assigned technology integration specialists (Jones & Dexter, 2014). While independent professional development includes activities that allow for individualized learning through the management and selection of content, co-construction of knowledge, demonstration of competencies, and generation of networks for ongoing learning outside of the school day and on the teacher's own time (Ross et al., 2015).

To answer this question, respondents in this study were asked to report the leadership actions their principals utilized to encourage participation in professional development. As a first step in answering this question, the data from survey question 17 was analyzed for frequency of response. Question 17 asked, "Of the instructional technology professional development you attended over the previous 12 months, did your principal take any of the following actions to encourage you to attend this instructional technology professional development?" Table 14 represents the percent of respondents who answered yes to this question. From this frequency analysis, respondents in this study reported that the most frequent leadership actions taken by principals were: *Highlights the one-to-one technology professional development taken by staff members to other staff and/or the community* (62.8%), *established trust and encouraged me to take risks in learning something with which I wasn't previously comfortable* (61.8%), and *encouraged me to model what I learned to my peers* (54.4%) (Table 14).

Table 14

Leadership Action Frequency for Supporting Professional Development

Leadership Action	Percent
Highlights the one-to-one technology professional development taken by staff members to other staff and/or the community (n=239)	62.8%
Established trust and encouraged me to take risks in learning something with which I wasn't previously comfortable (n=239)	61.9%
Encouraged me to model what I learned to my peers (n=241)	54.4%
Asked if I needed further one-to-one technology professional development (n=239)	48.1%
Provided suggestions for a professional learning community or collegial circle (n=236)	42.4%
Asks me for suggestions for professional development (n=235)	38.7%
Asked me to participate in a specific instructional technology professional development activity (n=236)	37.7%
Modeled or instructed the staff on independent professional learning (n=234)	37.6%
Provided release time during the school day for collaborative learning (n=237)	35.4%
Attended the instructional technology professional development with me (n=235)	29.4%
Asked me to join their PLN (n=233)	15.9%

The second approach to analysis for this question was to seek any relationships that may exist between leadership actions taken by principals and teacher participation in professional development. To accomplish this, question 17 was compared to questions 7 (teacher participation in formal professional development), 10 (teacher participation in informal professional development), and 13 (teacher participation in independent professional development) independently. While preparing for this analysis, it was determined that the not applicable (N/A) responses for question 17 would be omitted. This research question addresses a belief that either an action occurred or it didn't occur. Although the survey allowed for the selection of N/A affording the respondent the opportunity to indicate a nondefinitive response, this response does not support the relationship that the research question is addressing. That being said, this reasoning will be applied across all variables when a yes/no construct is used to address a research question.

To determine the statistical method to best describe the relationships between these variables, the data set was examined for normality. To accomplish this, the Shapiro-Wilk test for normality was performed between the leadership action variable of "asked if I needed further one-to-one technology professional development" and the variables of formal, informal, and independent professional development (Table 15.1-15.3). Results were significant ($p<.01$) across variables, indicating the data is non-normative and thus nonparametric (de Vries & Meys, 2015). As characteristics of the data set are similar across all variables, all relational analysis will apply nonparametric procedures based on these findings.

Table 15.1

Shapiro-Wilk Test for normality for formal professional development

	How many times have you participated in formal instructional technology professional development	Shapiro-Wilk Statistic	Df	Sig.
Asked if I needed further one-to-one technology professional development	0	.566	8	.000
	1-3	.616	76	.000
	4-6	.631	71	.000
	7-9	.590	25	.000
	10+	.591	34	.000

Table 15.2

Shapiro-Wilk Test for normality for informal professional development

	How many times have you participated in informal instructional technology professional development during the past twelve months	Shapiro-Wilk Statistic	Df	Sig.
Asked if I needed further one-to-one technology professional development	0	.664	7	.001
	1-3	.631	64	.000
	4-6	.630	35	.000
	7-9	.613	22	.000
	10+	.636	86	.000

Table 15.3

Shapiro-Wilk Test for normality for independent professional development

	How many times have you participated in independent instructional technology professional development	Shapiro-Wilk Statistic	Df	Sig.
Asked if I needed further one-to-one technology professional development	0	.637	41	.000
	1-3	.630	74	.000
	4-6	.634	27	.000
	7-9	.655	9	.000
	10+	.636	63	.000

To determine the relationship between the leadership actions of principals and teachers' willingness to participate in each of the forms of professional development, a Kendall's tau-b correlation coefficient was calculated. This test is an accepted procedure for determining

nonparametric ranked correlation when dealing with variables that are minimally on an ordinal scale (The Pennsylvania State University, 2017). The Kendall's tau b correlation coefficient is reported on a scale of -1 to 1, with zero indicating no relationship. The Kendall's tau b correlation coefficient indicates a weak correlation between .1 and .3, a moderate correlation between .31 and .5, and a strong correlation greater than .51 (Cohen, 1988).

The Kendall's tau b coefficients indicated there was a statistically significant relationship ($p<.01$ or $p<.05$) between teachers participating in formal professional development and the leadership actions of *asking if a teacher needs further one-to-one technology professional development* ($\tau_b=.224$, $p<.01$), *asking teachers to attend a specific professional development opportunity* ($\tau_b=.195$, $p<.01$), *attending professional development with the teacher* ($\tau_b=.192$, $p<.01$), and *establishing trust and encouraging the teacher to take risks* ($\tau_b=.142$, $p<.01$) (Table 16). The low coefficients indicate that a weak relationship exists between formal professional development and each of the leadership actions listed in Table 16.

Similarly, there was a statistically significant relationship ($p<.01$ or $p<.05$) between teachers participating in informal professional development and the leadership action of *asked me to join their PLN* ($\tau_b=.131$, $p<.05$) along with *established trust and encouraged me to take risks in learning something with which I wasn't previously comfortable* ($\tau_b=.130$, $p<.05$). Once again, the low coefficients indicate a weak association. Finally, there was a statistically significant relationship between teachers participating in independent professional development and the leadership actions of *asked me to participate in a specific instructional technology professional development activity* ($\tau_b=.137$) and *established trust and encouraged me to take risks in learning something with which I wasn't previously comfortable* ($\tau_b=.139$) (Table 16). These relationships were weak associations as the Kendall's tau b correlation coefficients were between .1 and .3.

Table 16

Leadership Action vs. Type of Professional Development Taken

Leadership Action	Type of PD	Kendall Tau b (τ_b)
Asked if I needed further one-to-one technology professional development	Formal	.224**
Attended the instructional technology professional development with me	Formal	.192**
Asked me to participate in a specific instructional technology professional development activity	Formal Independent	.195** .137*
Established trust and encouraged me to take risks in learning something with which I wasn't previously comfortable	Formal Informal Independent	.142* .130* .169**
Asked me to join their PLN	Informal	.131*

Note: Significance at *p < .05, **p < .01

Across all types of professional development, the only leadership action that was significant was *established trust and encouraged me to take risks in learning something with which I wasn't previously comfortable* (formal (τ_b=.142, p<.05), informal (τ_b=.130, p<.05), and independent (τ_b=.169, p<.01)). Although these relationships demonstrated a weak association, the relationship was statistically significant.

There was no statistically significant association between the leadership actions of *encouraged me to model what I learned to my peers, highlights the one-to-one technology professional development taken by staff members to other staff and/or the community, provided suggestions for a professional learning community or collegial circle, provided release time during the school day for collaborative learning, modeled or instructed the staff on independent professional learning, and asks me for suggestions for professional development*, and teachers participating in formal, informal, or independent professional development.

As various principal leadership actions have shown statistical significance to teachers participating in formal, informal, and independent professional development, the null hypothesis of H_0 = There is no relationship between principal leadership actions and teachers' willingness to participate in instructional technology professional development**,** is rejected. The next section will discuss how participating in each of the three forms of professional development affects the integration of instructional technology in the one-to-one classroom.

Research Question 2: Is there a relationship between professional development taken in instructional technology by teachers and the use of instructional technology integration in the middle school one-to-one classroom?

2a. Does participating in formal teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom? Respondents reported participating in all three forms of professional development with varying degrees of frequency (Table 17). These responses came from survey questions 7, 10, and 13 and asked, "How many times have you participated in (formal, informal, or independent) instructional technology professional development during the past 12 months." The majority of respondents in this study reported participating in formal professional development between one and six times per year (68.4%), with 15.1% participating in formal professional development 10 or more times per year (Table 17).

Table 17

Percent Frequency Participation (per year) for Each Type of Professional Development

Type of PD	0 Times	1-3 Times	4-6 Times	7-9 Times	10+ Times
Formal (n=298)	5.4%	36.9%	31.5%	11.1%	15.1%
Informal (n=292)	4.8%	30.8%	17.1%	9.9%	37.3%
Independent (n=285)	20.4%	35.8%	10.9%	5.6%	27.4%

Next, the data from survey questions eight and nine, which asked about teacher integration of technology in their classrooms after participating in formal professional development, were analyzed for frequency of response. These questions asked, "After participating in formal instructional technology professional development opportunities, I incorporated what I learned in the classroom by having students." Table 18 reports the frequency of a "yes," response to each of the integration actions. After participating in formal professional development, the greatest number of respondents in this study reported integrating instructional technology by *having students work collaboratively with their peers* (90.9%), *changed the way I deliver content and assess students* (86.5%), *having students work with peers to problem solve* (82.6%), and *complete online tasks that utilize critical thinking* (73.4%) (Table 18). Additionally, after participating in formal professional development, the majority of respondents in this study reported changing the manner in which they utilized instructional technology and integrated it into their classrooms by *differentiated learning tasks for individual students* (85.3%), and *communicate with students, parents, and peers* (83.5%) (Table 18).

Table 18

Formal Professional Development Integration Action Percentages

Integration Action	Percent Frequency
Work collaboratively with their peers (n=265)	90.9%
Changed the way I deliver content and assess students (n=267)	86.5%
Differentiated learning tasks for individual students (struggling and/or advanced) (n=266)	85.3%
Communicate with students, parents, and peers (n=261)	83.5%
Work with peers to problem solve (n=259)	82.6%
Allow students options for demonstrating understanding of a topic (n=265)	78.9%
Complete online tasks that utilize critical thinking (n=263)	73.4%
Create and deliver digital presentations (n=266)	72.2%
Incorporate project-based learning (n=259)	68.7%
Facilitate student collaboration beyond the classroom walls (n=262)	65.6%
Perform experiments and analyze information (n=255)	46.7%
Use social media for projects (n=252)	31.0%

A Kendall's tau b correlation coefficient was calculated to determine the relationship between participation in formal professional development and technology integration in the one-to-one classroom. There was statistical significance between formal professional development and all the integration actions asked in these questions. However, the greatest statistically significant relationship ($p<.01$ or $p<.05$) was between formal professional development and the integration action of *perform experiments and analyze information* ($\tau_b=.238$, $p<.01$). Additionally, the greatest statistically significant relationships after attending formal professional development and the integration actions the teachers implemented were *changed the way I deliver content and assess students* ($\tau_b=.265$, $p<.01$), and *communicate with students, parents, and peers* ($\tau_b=.212$, $p<.01$)

(Table 19). Several of the Kendall's tau b correlation coefficients were in the .2-.3 range for other leadership actions. Thus, even though these coefficients would indicate a weak association, there was a statistically significant relationship between participation in formal professional development and *perform experiments and analyze information* (τ_b=.238, p<.01), *changed the way I deliver content and assess students* (τ_b=.265, p<.01), and *communicate with students, parents, and peers* (τ_b=.212, p<.01). (Table 19). The remainder of the statistically significant relationships were weaker than these and the Kendall's tau b correlation coefficients were between .1 and .19.

Table 19

Relationship Between Type of Professional Development and Integration Action

Integration	Type of PD	Kendall Tau b (τ_b)
Perform experiments and analyze information	Formal	.238**
	Informal	.251**
	Independent	.251**
Complete online tasks that utilize critical thinking	Formal	.134*
	Informal	.206**
Work collaboratively with their peers	Formal	.195**
	Informal	.179**
	Independent	.172**
Use social media for projects	Formal	.150*
Work with peers to problem solve	Formal	.186**
	Informal	.201**
	Independent	.197**
Create and deliver digital presentations	Formal	.162**
Facilitate student collaboration beyond the classroom walls	Formal	.166**
Differentiated learning tasks for individual students (struggling and/or advanced)	Formal	.192**
	Informal	.156**
	Formal	.265**

Changed the way I deliver content and assess students	Informal	.143*
Communicate with students, parents, and peers	Formal	.212**
Incorporate project-based learning	Formal Independent	.175** .215**
Allow students options for demonstrating understanding of a topic	Formal	.241**

Note: Significance at *p < .05. **p < .01.

2b. Does participating in informal teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom? The majority of teachers in this study reported participating in informal professional development predominantly between one to three times per year (30.8%) or over ten times per year (37.3%) (Table 17).

Table 20

Informal Professional Development Integration Action Percentages

Integration Action	Percent Frequency
Work collaboratively with their peers (n=258)	87.6%
Changed the way I deliver content and assess students (n=264)	86.0%
Work with peers to problem solve (n-=262)	85.9%
Differentiated learning tasks for individual students (struggling and/or advanced) (n=260)	80.8%
Communicate with students, parents, and peers (n=260)	80.4%
Allow students options for demonstrating understanding of a topic (n=264)	78.8%
Complete online tasks that utilize critical thinking (n=260)	71.9%
Create and deliver digital presentations (n=266)	71.8%
Facilitate student collaboration beyond the classroom walls (n=258)	66.3%
Incorporate project-based learning (n=256)	66.0%
Perform experiments and analyze information (n=258)	46.5%
Use social media for projects (n=255)	29.8%

The data from survey questions 11 and 12, which asked about teacher integration of technology in their classrooms after participating in informal professional development, were

analyzed for frequency of response. These questions asked, "After participating in informal instructional technology professional development opportunities, I incorporated what I learned in the classroom by having students." Table 20 reports the frequency of a "yes," response to each of the integration actions. After participating in informal professional development, the greatest number of respondents in this study reported integrating instructional technology by having students *work collaboratively with their peers* (87.6%) and *work with peers to problem solve* (85.9%) (Table 20). Additionally, after participating in informal professional development, the majority of respondents in this study reported changing the manner in which they utilized instructional technology and integrate it into their classrooms is by *differentiated learning tasks for individual students* (80.8%), *changed the way I deliver content and assess students* (86.0%), and *communicate with students, parents, and peers* (80.4%) (Table 20).

A Kendall's tau b correlation coefficient was calculated to determine the relationship between participation in informal professional development and technology integration in the one-to-one classroom. There was a statistically significant relationship ($p<.01$ or $p<.05$) between informal professional development and the integration action of having students *perform experiments and analyze information* ($\tau_b=.251$, $p<.01$), *complete online tasks that utilize critical thinking* ($\tau_b=.206$, $p<.01$), *work collaboratively with their peers* ($\tau_b=.179$, $p<.01$), and *work with peers to problem solve* ($\tau_b=.201$, $p<.01$) (Table 19). There was also a relationship between participating in informal professional development and the way teachers in the one-to-one classrooms in this study *changed the way I differentiated learning tasks for individual students (struggling and/or advanced)* ($\tau_b=.156$, $p<.01$), and *changed the way I delivered content and assessed students* ($\tau_b=.143$, $p<.05$) (Table 19). Although many of the Kendall's tau b correlation coefficients were between .1 and .2, indicating a very weak relationship, several of the Kendall's

tau b correlation coefficients were in the .2-.3 range. The coefficients in the .2 to .3 range would indicate a weak relationship between participation in informal professional development and having students *perform experiments and analyze information* (τ_b=.251, p<.01), *complete online tasks that utilize critical thinking* (τ_b=.206, p<.01), and *work with peers to problem solve* (τ_b=.201) (Table 19).

2c. Does participating in independent teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom? A high percentage of the respondents participating in this study reported never attending independent professional development (20.4%). While at the same time, 27.4% of the respondents in this study reported utilizing independent professional development 10 or more times per year (Table 17).

The data from survey questions 14 and 15, which asked about teacher integration of technology in their classrooms after participating in independent professional development, were analyzed for frequency of response. These questions asked, "After participating in independent instructional technology professional development opportunities, I incorporated what I learned in the classroom by having students." Table 21 reports the frequency of a "yes," response to each of the integration actions. After participating in independent professional development, the greatest number of respondents in this study reported integrating instructional technology by having students *work collaboratively with their peers* (81.4%) and *work with peers to problem solve problem* (79.8%) (Table 21). Additionally, after participating in independent professional development, the majority of respondents in this study reported they changed the manner in which they utilized instructional technology and integrated it into their classrooms by *differentiated learning tasks for individual students* (82.1%), *changed the way I deliver content and assess students* (85.3%), and *communicate with students, parents, and peers* (80.4%) (Table 21).

Table 21

Independent Professional Development Integration Action Percentages

Integration Action	**Percent Frequency**
Changed the way I deliver content and assess students (n=217)	85.3%
Differentiated learning tasks for individual students (struggling and/or advanced) (n=218)	82.1%
Work collaboratively with their peers (n=215)	81.4%
Communicate with students, parents, and peers (n=214)	80.4%
Work with peers to problem solve (n=213)	79.8%
Allow students options for demonstrating understanding of a topic (n=212)	78.8%
Create and deliver digital presentations (n=213)	71.4%
Complete online tasks that utilize critical thinking (n=212)	69.8%
Incorporate project-based learning (n=213)	68.5%
Facilitate student collaboration beyond the classroom walls (n=213)	63.8%
Perform experiments and analyze information (n=212)	50.5%
Use social media for projects (n=208)	37.5%

A Kendall's tau b correlation coefficient was calculated to determine the relationship between participation in independent professional development and technology integration in the one-to-one classroom. There was a statistically significant relationship ($p<.01$ or $p<.05$) between participation in independent professional development and the integration action of having students *perform experiments and analyze information* ($\tau_b=.251$, $p<.01$), having students *work with their peers to problem solve* ($\tau_b=.197$, $p<.01$) and *collaborate with their peers* ($\tau_b=.172$, $p<.01$) (Table 19). Respondents in this study also reported changing or increasing the way they integrated instructional technology in the classroom after participating in independent professional development by *developing lessons that incorporate project-based learning* ($\tau_b=.215$, $p<.01$) (Table 19).

Although two of the Kendall's tau b correlation coefficients were between .1 and .2, having students *work with their peers to problem solve* (τ_b=.197, p<.01) and *collaborate with their peers* (τ_b=.172, p<.01) indicating a very weak relationship, two of the Kendall's tau b correlation coefficients were in the .2-.3 range. The two coefficients in the .2 to .3 range would indicate a weak relationship between participation in independent professional development and having students *perform experiments and analyze information* (τ_b=.251, p<.01) and *developing lessons that incorporate project-based learning* (τ_b=.215, p<.01) (Table 19).

As there were statistically significant relationships between participation in each of the three forms of professional development and the integration of instructional technology, the null hypothesis of H_0 = There is no relationship between participating in any of the three forms of professional development and the level of instructional technology integration in the one-to-one classroom, is rejected. In the next section, the same instructional technology integrations will be examined to identify any possible relationships to the leadership actions principals take to encourage teachers to integrate instructional technology in the one to one classroom.

Research Question 3: Is there a relationship between the leadership actions of principals and the integration of instructional technology in the one-to-one classroom?

Respondents in this study were asked whether their principals demonstrated specific leadership actions to encourage them to integrate instructional technology in their classrooms. The first level of analysis to answer this question included calculating the frequency of response to survey question 16 which asked, "Of the instructional technology professional development you attended over the previous 12 months, did your principal take any of the following actions to encourage you to integrate this instructional technology in your one-to-one classroom?" Table 22 reports the frequency of a "yes," response to each of the leadership actions. From the results to

this question, respondents in this study reported that principals take the actions of *communicates the goals of the one-to-one technology initiative in my school* 65.9% of the time, *encouraged and provided positive reinforcement for me to integrate one-to-one technology* 63% of the time, *established trust and encouraged me to take risks integrating one-to-one technology* 68.1% of the time, and *highlights successful one-to-one technology integration by staff members to other staff and/or the community* 71.8% of the time (Table 22).

Table 22

Leadership Action Frequencies for Supporting Instructional Technology Integration

Leadership Action	**Percent**
Highlights successful one-to-one technology integration by staff members to other staff and/or the community (n=255)	71.8%
Established trust and encouraged me to take risks integrating one-to-one technology (n=254)	68.1%
Communicates the goals of the one-to-one technology initiative in my school (n=258)	65.9%
Encouraged and provided positive reinforcement for me to integrate one-to-one technology (n=257)	63.0%
Actively sought the resources I needed to integrate one-to-one technology successfully (n=255)	48.2%
Asked if I needed further one-to-one technology professional development (n=257)	47.5%
Encouraged me to model how I am integrating one-to-one technology to my peers (n=252)	46.3%
Used evaluations to reinforce the importance of one-to-one technology integration in my lessons (n=256)	43.0%
Provided release time to collaborate and plan with other teachers to integrate one-to-one technology in the classroom (n=255)	41.2%
Modeled one-to-one technology use (n=248)	27.0%
Worked collaboratively with me to integrate one-to-one technology in my lessons (n=253)	19.0%

The second level of analysis included determining if there are any statistically significant relationships between the leadership actions of principals and the integration of instructional

technology in the one-to-one classroom. For this, the data set was analyzed using a chi-square and the Fisher's Exact Test. The Fisher's Exact Test is a widely accepted procedure when analyzing 2 X 2 categorical, nominal data (Laerd Statistics Premium, 2016). When statistically significant, the null hypothesis (There is no relationship between principal leadership actions and teachers' integration of instructional technology in the one-to-one classroom) is rejected (Laerd Statistics Premium, 2016).

After determining statistical significance, the phi coefficient (r_φ) was utilized to determine the strength of the relationship between the leadership actions of principals and the integration of instructional technology. According to "Phi Coefficient (Mean Square Contingency Coefficient), 2016, if the phi value is 0, there is no relationship, .01-.19 a negligible relationship, .2-.29 a weak relationship, .3-.39 a moderate relationship, .4-.69 a strong relationship, and plus .7 a very strong relationship. This is the scale that was used when reporting the strength of the relationships in this study.

Additionally, for this data set, the relationship between the principal's leadership actions and the integration of instructional technology was determined after the teacher attended one of the three forms of professional development. Thus, the analysis will be separated first by type of professional development followed by an overall analysis of all three types of professional development combined.

Tables 23.1- 23.11

Leadership Actions vs. Integrations by Type of Professional Development Participation

23.1	**Communicates the goals of the one-to-one technology initiative in my school**	
Type of PD	**Integration**	**Phi (r_φ)**
Formal	Work collaboratively with their peers	.202**
	Work with peers to problem solve	.229**

	Create and deliver digital presentations	.197**
	Facilitate student collaboration beyond the classroom walls	.285**
	Changed the way I deliver content and assess students	.196**
	Communicate with students, parent, and peers	.148*
	Incorporate project-based learning	.152*
Informal	Perform experiments and analyze information	.185*
	Complete online tasks that utilize critical thinking	.223**
Independent	None	

Note: Significance at *p < .05. **p < .01.

23.2	**Used evaluations to reinforce the importance of one-to-one technology integration in my lessons**	
Type of PD	**Integration**	**Phi (r_φ)**
Formal	Perform experiments and analyze information	.257**
	Use social media for projects	.240**
	Create and deliver digital presentations	.215**
	Facilitate student collaboration beyond the classroom walls	.239**
	Incorporate project-based learning	.184*
Informal	Perform experiments and analyze information	.215**
	Use social media for projects	.160*
	Create and deliver digital presentations	.164*
	Facilitate student collaboration beyond the classroom walls	.166*
	Communicate with students, parent, and peers	.265**
	Incorporate project-based learning	.188*
	Allow students options for demonstrating understanding of a topic	.175*
Independent	Perform experiments and analyze information	.183*
	Complete online tasks that utilize critical thinking	.179*
	Use social media for projects	.174*
	Create and deliver digital presentations	.177*
	Facilitate student collaboration beyond the classroom walls	.271**
	Differentiated learning task for individual students	.185*
	Communicate with students, parent, and peers	.187*
	Incorporate project-based learning	.244**

Note: Significance at *p < .05. **p < .01.

23.3	**Provided release time to collaborate and plan with other teachers to integrate one-to-one technology in the classroom**	
Type of PD	**Integration**	**Phi (r_φ)**
Formal	Facilitate student collaboration beyond the classroom walls	.196**
	Incorporate project-based learning	.169*
Informal	Incorporate project-based learning	.200**

Independent	Facilitate student collaboration beyond the classroom walls	.313**
	Incorporate project-based learning	.178*

Note: Significance at *p < .05. **p < .01.

23.4	**Asked if I needed further one-to-one technology professional development**	
Type of PD	**Integration**	**Phi (r_φ)**
Formal	Use social media for projects	.158*
	Facilitate student collaboration beyond the classroom walls	.185*
	Differentiated learning task for individual students	.161*
	Allow students options for demonstrating understanding of a topic	.144*
Informal	Allow students options for demonstrating understanding of a topic	.158*
Independent	None	

Note: Significance at *p < .05. **p < .01.

23.5	**Actively sought the resources I needed to integrate one-to-one technology successfully**	
Type of PD	**Integration**	**Phi (r_φ)**
Formal	Work with peers to problem solve	.197*
	Facilitate student collaboration beyond the classroom walls	.336**
	Differentiated learning task for individual students	.242**
	Changed the way I deliver content and assess students	.162*
	Incorporate project-based learning	.194*
Informal	Work with peers to problem solve	.193**
	Differentiated learning task for individual students	.197**
	Incorporate project-based learning	.196**
Independent	Facilitate student collaboration beyond the classroom walls	.225**

Note: Significance at *p < .05. **p < .01.

23.6	**Worked collaboratively with me to integrate one-to-one technology in my lessons**	
Type of PD	**Integration**	**Phi (r_φ)**
Formal	Perform experiments and analyze information	.191*
	Use social media for projects	.319**
	Facilitate student collaboration beyond the classroom walls	.295**
	Differentiated learning task for individual students	.177**
	Allow students options for demonstrating understanding of a topic	.193**
Informal	Use social media for projects	.268**
	Facilitate student collaboration beyond the classroom walls	.191**
	Allow students options for demonstrating understanding of a topic	.163*
Independent	Use social media for projects	.344**
	Facilitate student collaboration beyond the classroom walls	.318**

	Differentiated learning task for individual students	.214**
	Incorporate project-based learning	.178*
	Allow students options for demonstrating understanding of a topic	.210**

Note: Significance at *p < .05. **p < .01.

23.7	**Modeled one-to-one technology use**	
Type of PD	**Integration**	**Phi (r_φ)**
Formal	None	
Informal	None	
Independent	None	

Note: Significance at *p < .05. **p < .01.

23.8	**Encouraged me to model how I am integrating one-to-one technology to my peers**	
Type of PD	**Integration**	**Phi (r_φ)**
Formal	Create and deliver digital presentations	.156*
	Facilitate student collaboration beyond the classroom walls	.310**
Informal	Perform experiments and analyze information	.222**
	Use social media for projects	.188*
	Facilitate student collaboration beyond the classroom walls	.263**
	Differentiated learning task for individual students	.163*
Independent	Use social media for projects	.252**

Note: Significance at *p < .05. **p < .01.

23.9	**Encouraged and provided positive reinforcement for me to integrate one-to-one technology**	
Type of PD	**Integration**	**Phi (r_φ)**
Formal	Perform experiments and analyze information	.196*
	Complete online tasks that utilize critical thinking	.153*
	Work with peers to problem solve	.179*
	Create and deliver digital presentations	.204**
	Facilitate student collaboration beyond the classroom walls	.175*
	Incorporate project-based learning	.228**
Informal	Perform experiments and analyze information	.183*
	Work collaboratively with their peers	.162*
	Differentiated learning task for individual students	.161*
	Incorporate project-based learning	.165*
	Allow students options for demonstrating understanding of a topic	.214**
Independent	Facilitate student collaboration beyond the classroom walls	.191*
	Differentiated learning task for individual students	.184*
	Incorporate project-based learning	.174*

Note: Significance at *p < .05. **p < .01.

23.10	**Established trust and encouraged me to take risks integrating one-to-one technology**	
Type of PD	**Integration**	**Phi (r_φ)**
Formal	None	
Informal	None	
Independent	None	

Note: Significance at *p < .05. **p < .01.

23.11	**Highlights successful one-to-one technology integration by staff members to other staff and/or the community**	
Type of PD	**Integration**	**Phi (r_φ)**
Formal	Complete online tasks that utilize critical thinking	.210**
	Create and deliver digital presentations	.159*
	Facilitate student collaboration beyond the classroom walls	.177*
	Incorporate project-based learning	.199**
Informal	Incorporate project-based learning	.188*
Independent	Facilitate student collaboration beyond the classroom walls	.189*

Note: Significance at *p < .05. **p < .01.

Formal professional development: Respondents in this study reported that after participating in formal professional development, when the principal *communicates the goals of the one-to-one technology initiative in my school*, the greatest number of statically significant relationships to instructional technology actions occurred, although negligible to weak relationships exists between the variable pairs (Table 23.1). The respondents reported they *integrated instructional technology in their classrooms by having students work collaboratively with their peers* (r_φ=.202, p<.01), *work with peers to problem solve* (r_φ=.229, p<.01), and *create and deliver digital presentations* (rφ=.197, p<.01). This same leadership action also caused the teachers to *facilitate student collaboration beyond the classroom walls* (r_φ=.285, p<.01), *changed the way I delivered content and assessed students* (r_φ=.196, p<.01), *communicate with students, parent, and peers* (rφ=.148, p<.05), and *incorporate project-based learning* (r_φ=.152, p<.05) (Table 23.1).

Further, although the relationships here are characterized as weak (Phi coefficients **(**r_φ) are between .2 and .29) after teachers participated in formal professional development, the relationships between *communicates the goals of the one-to-one technology initiative in my school* and the integration actions of *work collaboratively with their peers* (r_φ=.202, p<.01), *work with peers to problem solve* (r_φ=.229, p<.01), and *facilitate student collaboration beyond the classroom walls* (r_φ=.285, p<.01) are statistically significant (Table 23.1).

Similarly, there was a statistically significant relationship between nine of the leadership actions and *facilitate student collaboration beyond the classroom walls*. These leadership actions include: *communicating the goals of the one-to-one technology initiative in my school* (r_φ=.285, p<.01), *used evaluations to reinforce the importance of one-to-one technology integration in my lessons* (r_φ=.239, p<.01), *provided release time to collaborate and plan with other teachers to integrate one-to-one technology in the classroom* (r_φ=.196, p<.01), *asked if I needed further one-to-one technology professional development* (r_φ=.185, p<.05), *actively sought the resources I needed to integrate one-to-one technology successfully* (r_φ=.336, p<.01), *worked collaboratively with me to integrate one-to-one technology in my lessons* (r_φ=.319, p<.01), *encouraged me to model how I am integrating one-to-one technology to my peers* (r_φ=.310, p<.01), *encouraged and provided positive reinforcement for me to integrate one-to-one technology* (r_φ=.175, p<.05), and *highlights successful one-to-one technology integration by staff member to other staff members and/or the community* (r_φ=.177, p<.05) (Tables 23.1, 23.2, 23.3, 23.4, 23.5, 23.6, 23.8, 23.11).

After teachers participated in formal professional development, there was a moderate association between *facilitate student collaboration beyond the classroom walls* and the leadership actions of *actively sought the resources I needed to integrate one-to-one technology successfully* (r_φ=.336, p<.01), *worked collaboratively with me to integrate one-to-one technology in my lessons*

(r_φ=.319, p<.01), and *encouraged me to model how I am integrating one-to-one technology to my peers* (r_φ=.310, p<.01) and this is indicated by Phi coefficients **(**r_φ) between .3 and .39. There is also statistically significant relationship between *facilitate student collaboration beyond the classroom walls* and the leadership actions of *communicating the goals of the one-to-one technology initiative in my school* (r_φ=.285, p<.01), and *used evaluations to reinforce the importance of one-to-one technology integration in my lessons* (r_φ=.239, p<.01), although weaker than those relationships with Phi coefficients between .3 and .39 (Tables 23.1, 23.2, 23.3, 23.4, 23.5, 23.6, 23.8, 23.11).

Informal professional development: After participating in informal professional development, when the principal *used evaluations to reinforce the importance of one-to-one technology*, the greatest number of statistically significant relationships to instructional technology actions occurred and a weak association occurred between variable pairs (Table 23.2). The respondents integrated instructional technology in their classrooms by having students *perform experiments and analyze information* (r_φ=.215, p<.01), *use social media for projects* (r_φ=.160, p<.05) and *create and deliver digital presentations* (r_φ=.164, p<.05). This same leadership action also caused the teachers to: *facilitate student collaboration beyond the classroom walls* (r_φ=.166, p<.05), *communicate with students, parent, and peers* (r_φ=.265, p<.01), *incorporate project-based learning* (r_φ=.188, p<.05), and *allow students options for demonstrating understanding of a topic* (r_φ=.175, p<.05). (Table 23.2). Most of the relationships noted above were negligible, however, there was a statistically significant relationship, although weak, between the leadership action of *used evaluations to reinforce the importance of one-to-one technology* and *perform experiments and analyze information* (r_φ=.215, p<.01) and *communicate with students, parent, and peers* (r_φ=.265, p<.01) after participating in informal professional development.

Similarly, the result of analysis showed a statistically significant relationship between five leadership actions taken by their principals and the integration actions of *incorporate project-based learning* after they participated in informal professional development. These leadership actions include: *used evaluations to reinforce the importance of one-to-one technology* (r_{φ}=.188, p<.05), *provided release time to collaborate and plan with other teachers to integrate one-to-one technology in the classroom* (r_{φ}=.200, p<.01), *actively sought resources I needed to integrate one-to-one technology successfully* (r_{φ}=.196, p<.01), *encouraged and provided positive reinforcement for me to integrate one-to-one technology* (r_{φ}=.165, p<.05), and *highlights successful one-to-one technology integration by staff member to other staff members and/or the community* (r_{φ}=.188, p<.05) (Tables 23.2, 23.3, 23.5, 23.9, 23.11). Each of the associations between *incorporate project-based learning* and the leadership actions is a negligible association as the Phi coefficient is between .1 and .9 except for *provided release time to collaborate and plan with other teachers to integrate one-to-one technology in the classroom* (r_{φ}=.200, p<.01) which demonstrated a weak association to incorporate project-based learning after teachers in this study participated in informal professional development.

Additionally, the respondents in this study identified that none of the leadership actions caused teachers to *change the way I delivered content and assess students* (Tables 23.1-23.11).

Independent professional development: After participating in independent professional development, when the principal *used evaluations to reinforce the importance of one-to-one technology*, the greatest number of statistically significant relationships to instructional technology actions were found (Table 23.2). The respondents integrated instructional technology in their classrooms by having students *perform experiments and analyze information* (r_{φ}=.183, p<.05), *complete online tasks that utilize critical thinking* (r_{φ}=.179, p<.05), *use social media for projects*

(r_φ=.174, p<.05), and *create and deliver digital presentations* (r_φ=.177, p<.05). This same leadership action also caused the teachers to: *facilitate student collaboration beyond the classroom walls* (r_φ=.271, p<.01), *differentiate learning tasks for individual students* (r_φ=.185, p<.05), *communicate with students, parent, and peers* (r_φ=.187, p<.05), and *incorporate project-based learning* (r_φ=.224, p<.01) (Table 23.2). The relationships between the leadership action of *used evaluations to reinforce the importance of one-to-one technology* and the integration actions of *facilitate student collaboration beyond the classroom walls* (r_φ=.271, p<.01) and *incorporate project-based learning* (r_φ=.224, p<.01) were weak after teachers participated in independent professional development, yet this indicates a statistically significant relationship higher than the remainder of the associations which were negligible as the Phi coefficients were between .1 and .19 (Table 23.2)

Similarly, there was a relationship between six of the leadership actions and the integration action of *facilitate student collaboration beyond the classroom walls*. These leadership actions include: *used evaluations to reinforce the importance of one-to-one technology integration in their lessons* (r_φ=.271, p<.01), *provided release time to collaborate and plan with other teachers to integrate one-to-one technology in the classroom* (r_φ=.313, p<.01), *actively sought the resources I needed to integrate instructional technology successfully* (r_φ=.225, p<.01), *worked collaboratively with me to integrate one-to-one technology in my lessons* (r_φ=.318, p<.01), *encouraged and provided positive reinforcement for me to integrate one-to-one technology* (r_φ=.191, p<.05), and *highlights successful one-to-one technology integration by staff member to other staff members and/or the community* (r_φ=.189, p<.05) (Tables 23.2, 23.3, 23.5, 23.6, 23.9, 23.11). After teachers participated in independent professional development, there was a moderate association between *facilitate student collaboration beyond the classroom walls* and the leadership actions of *provided*

release time to collaborate and plan with other teachers to integrate one-to-one technology in the classroom (r_φ=.313, p<.01) and *worked collaboratively with me to integrate one-to-one technology in my lessons* (r_φ=.318, p<.01) and this is indicated by Phi coefficients **(**r_φ) between .3 and .39. There is also statistically significant relationship between *facilitate student collaboration beyond the classroom walls* and the leadership actions of *used evaluations to reinforce the importance of one-to-one technology integration in their lessons* (r_φ=.271, p<.01) and *actively sought the resources I needed to integrate instructional technology successfully* (r_φ=.225, p<.01), although weaker than those relationships with Phi coefficients between .3 and .39 (Tables 23.2, 23.3, 23.5, 23.6, 23.9, 23.11).

Additionally, none of the leadership actions were statistically significant to have *students work collaboratively with their peers, work with peers to problem solve, or changed the way I deliver content or assess students* after teachers participated in independent professional development (Tables 23.1-23.11).

As a result of the above analysis, the null hypothesis of H_0 = There is no relationship between principal leadership actions and teachers' integration of instructional technology in the one-to-one classroom**,** is rejected, although results varied across the leadership actions and the instructional technology integrations after teachers attended the various types of professional development. A few relationships emerged without difference to the type of professional development in which the respondents participated. The leadership action of *used evaluations to reinforce the importance of one-to-one technology* showed the greatest number of relationships to integrations without regard to the type of professional development in which a teacher participated (Table 23.2). Similarly, when a principal *provides release time for teachers to collaborate*, there is a relationship to teachers integrating *project-based learning activities*, and this is not related to

the type of professional development in which a teacher participates (formal (r_φ=.169, p<.05, informal (r_φ=.200, p<.01), independent (r_φ=.178, p<.05) (Table 23.3).

From Tables 23.1-23.11, the integration action of *incorporate project-based learning* had the most frequent statistically significant relationships to the leadership actions above other forms of integration, independent of the type of professional development in which teachers participated. Finally, the leadership actions of *modeled one-to-one technology use* (Table 23.7) and *established trust and encouraged me to take risks integrating one-to-one technology* (Table 23.10) had no statistically significant effect on teachers' willingness to integrate the instructional technology, and this result was similar across all three types of professional development.

Research Question 4: What are the teacher biases and barriers toward instructional technology and the integration of instructional technology in the one-to-one classroom?

The data sets utilized to answer these questions were derived from responses to survey questions 18-20. The data sets were analyzed using a descriptive approach to analysis.

Barriers: To determine the barriers teachers experience in integrating instructional technology in the one-to-one setting, the data set was analyzed using the responses to question 18 from the survey which states, "Do you perceive any of the following obstacles to integrating technology in your classroom (check all that apply)." These results were analyzed in SPSS for frequency of response and the results are displayed in Table 24. Respondents (n=262) were allowed to select more than one of each response. As respondents were allowed to select more than one response for this question, the total number of responses for all choices was 719.

Table 24

Frequency of Barriers to Integrating Instructional Technology

Barrier	Number of Responses
Lack of time to plan	154
Lack of time to collaborate with peers	153
Lack of time to learn and experiment	145
Lack of time because of outside factors	121
Lack of hardware/software	42
Lack of professional development	45
None of the above	21
Other	
Technology/Network troubles	5

Based on the responses from this study, a lack of time (to plan, collaborate with peers, to learn and experiment, and because of outside factors) is chosen most often as a barrier to the integration of instructional technology in the one-to-one classroom. In this study, respondents reported a lack of time to plan 154 times, a lack of time to collaborate with their peers 153 times, a lack of time to learn and experiment 145 times, and a lack of time because of outside factors 121 times (Table 24).

Professional development was only reported as a barrier to integration of instructional technology by 45 of the respondents and 21 respondents in this study did not identify any of the options listed as a barrier to integrating instructional technology. Only five respondents identified poor technology and/or network issues as a barrier to integration of instructional technology in the one-to-one classroom.

Beliefs about integrating instructional technology. Question 19 from the survey asked respondents to rank on a Likert scale, from strongly disagree (1) to strongly agree (5), to six statements concerning their beliefs about integrating instructional technology in the one-to-one classroom. The data was analyzed in SPSS at the descriptive level by frequency of response and the data was summarized for the mean, and standard deviation as identified in Table 25.

Table 25

Beliefs about Integrating Instructional Technology

	N	Mean	Std. Deviation (SD)
I believe I have the ability to learn new instructional technologies and integrate them in my classroom	262	4.47	.805
I believe there is an appropriate amount of support in my school to learn and integrate technology in my classroom	262	3.80	1.101
I believe time to plan is important for instructional technology integration	262	4.61	.812
I believe time to collaborate is important for instructional technology integration	262	4.58	.821
I believe time to learn new instructional technologies is important for technology integration	262	4.65	.743
I believe if I attend PD, the school will provide me with the resources I need to implement what I have learned	263	3.80	1.047

The respondents in this study indicated strongest levels of agreement with time is provided to plan (Mean=4.61), and collaborate (Mean=4.58), and if they are supplied with time to learn new instructional technologies (Mean=4.65), as their strongest beliefs about integrating instructional technology. However, as the standard deviations to these statements are approaching 1.0, this would indicate that the respondents' answers varied from agree to strongly agree. Further, the teacher respondents in this study indicated ambivalence about the amount of support available to them in their schools (Mean=3.8) and that resources will be forthcoming after they attend professional development (Mean=3.8). However, the standard deviations for this data set, being higher than 1.0, indicate a variance in the distribution of responses from disagree to agree to these two statements (Table 25).

Beliefs about one-to-one technology: Similar to beliefs about integrating instructional technology, question 20 from the survey asked teacher respondents to rank on a Likert scale, from strongly disagree (1) to strongly agree (5), six statements concerning their beliefs about one-to-one technology in general. The data was analyzed in SPSS at the descriptive level by frequency of response and the data was summarized for the mean, mode, and standard deviation as identified in Table 26.

Table 26

Beliefs about One-to-One Technology

	N	Mean	Mode	Std. Deviation (SD)
I believe that instructional technology in a one-to-one environment has the ability to positively increase student achievement and impact learning	260	4.17	4.00	.886
I believe that all students should have a device at all times of the day for instruction	261	3.25	2.00	1.352
I believe if all students have a device in my class that I will need to change my pedagogical practices to deliver content	262	3.59	4.00	1.193
I believe if all students have a device, that they will learn the content differently than the way students learn without the devices	258	3.80	4.00	1.049
I understand the instructional technology one-to-one vision of my school	260	3.89	4.00	.957
I support the instructional technology one-to-one vision of my school	260	3.91	4.00	1.000

Respondents in this study reported they agreed that *instructional technology in a one-to-one environment has the ability to positively increase student achievement and impact learning*

(Mean=4.17) and that *if all students have a device, they will learn the content differently than the way students learn without the devices* (Mean=3.8). However, as the standard deviations are close to 1.0, this would indicate a variance from no opinion to strongly agree for these statements. Additionally, respondents in this study reported that they *both understand the one-to-one vision of their school* (Mean=3.89) and *support it as well* (Mean=3.91). Although the means from these two responses indicate agreement to these statements, there is once again a variation in their responses from no opinion to strongly agree as the standard deviation for both statements are close to 1.0 (Table 26).

Respondents in this study also believed that *if all students have a device in my class that I will need to change my pedagogical practices to deliver content* (Mean=3.59, Mode=4.0), but again with a variety of agreement as demonstrated by the standard deviation of 1.193. The greatest variation in responses concerned the statement, *I believe that all students should have a device at all times of the day for instruction* (Mean=3.25, Mode=2.0). Respondents indicated they were undecided about this statement with the majority of responses being disagree. However, based on the standard deviation of 1.352, responses to this statement indicate respondents in this study had a wide range of beliefs concerning this statement (Table 26).

Summary

The purpose of this chapter was to present the findings from the responses teachers provided to a 20-question survey that addressed the questions of this study. The data was analyzed using the SPSS statistical analysis software to identify relationships between leadership actions and teacher participation in professional development, teacher participation in different types of professional development and instructional technology integration, and the leadership actions of principals and instructional technology integration in the one-to-one classroom. Additionally,

teacher responses about the perceived barriers to and beliefs about instructional technology, its integration in the classroom, and one-to-one initiatives in general were analyzed.

There was a statistically significant relationship between several of the reported leadership actions and teacher participation in formal, informal, and independent professional development. Through the analysis of the data, the leadership actions that created the greatest participation in any form of professional development was establishing trust and encouraging teachers to take risks. At the same time, when principals were reported to perform the leadership actions of encouraging teachers to model what they have learned, highlighting the professional development taken to other staff members and the community, providing suggestions for professional learning communities or collegial circles, providing release time for collaboration, modeling independent professional learning, and asking the teacher for suggestions for professional development, there was no significant correlation to teachers participating in formal, informal, or independent professional development.

Respondents reported that after participating in formal professional development they integrated every form of instructional technology asked on this survey. Similarly, after participating in informal professional development, teachers reported integrating half of the integrations asked in this survey. Finally, independent professional development was related to the least number of integration actions of the three forms of professional development with only four integration actions reported by the teachers in this study. The highest associations were found between independent professional development and having students perform and analyze information and developing lessons that incorporate project-based learning.

There were several leadership actions that demonstrated a relationship to different forms of integration. The leadership action of using evaluations to reinforce the importance of one-to-

one technology integration in a teacher's lessons as being related to more integrations than any other leadership action asked in this study. Additionally, project-based learning is related to more of the leadership actions cited than any of the other forms of integration asked in this study. However, the leadership actions of modeling one-to-one technology use and establishing trust and encouraging teachers to take risks had no significant effect on teachers' willingness to integrate instructional technology.

Respondents indicated that a lack of time, in a variety of forms, poses the greatest barrier to the integration of instructional technology in the one-to-one classroom. This result is similar to respondents in this study reporting the belief that if they had more time, they would be better able to integrate instructional technology. Finally, when asked about their beliefs about one-to-one technology, respondents indicated they know and understand the one-to-one vision in their schools as well as the belief that one-to-one technology increases student achievement and allows students to learn differently. However, respondents overwhelmingly disagree with the concept that all students should have a device at all times of the day for instruction.

The findings presented in this chapter will serve as the foundation for the discussion, conclusions, and recommendations presented in Chapter 5 of this paper.

Chapter 5:
Discussion, Conclusion, Recommendations

Introduction

Over the past ten years, districts have been making large purchases of instructional technology for use in the classroom. In particular, many districts are purchasing one device per one student, otherwise known as one-to-one initiatives (Dorfman, 2016). The success or failure of these initiatives depends largely on how the teacher integrates these devices into the curriculum and not the initiative itself (Spires et al., 2012). However, there are multiple barriers and beliefs that need to be overcome on the part of the teacher before he/she feels comfortable integrating technology from a pedagogical perspective (Brinkerhoff, 2006; Ertmer, 2005).

To overcome these barriers and beliefs, teachers need professional development in a variety of forms: formal, informal, and independent (Jones & Dexter, 2014). Additionally, educational leaders, particularly principals, need to take an active role through their leadership actions in making certain teachers receive the professional development they need to support technology integration actions in the classroom. This is known as digital leadership (Chang, 2012; Shuldman, 2004; U.S. Department of Education, 2016). The principal leadership role in supporting initiatives that integrate instructional technology is paramount with regard to the successful execution of the technology integration strategy (Chang, 2012).

As one-to-one initiatives are emerging in larger numbers, research concerning effective leadership actions for professional development and instructional technology integration in these settings is relatively scarce. Additionally, it has not been established if the forms of professional development in which teachers in these settings participate are the most effective for instructional technology integration. Finally, although teacher beliefs and the barriers to instructional

technology integration have been widely researched, there is little evidence in the literature concerning these beliefs and barriers in the one-to-one setting.

The purpose of this study was to examine the relationship between formal, informal, and independent instructional technology professional development offerings, the leadership actions of principals and teacher biases and barriers, and their influence on public middle school teachers' integration of instructional technology in a one-to-one environment. This quantitative, correlational design study will be examined through analysis of survey results and the conceptual framework of Digital Leadership and the Technology, Pedagogy and Content Knowledge (TPACK) framework. The population for this study will be public middle school teachers of grades five through eight teaching in a one-to-one environment on Long Island, New York.

A survey was developed and analyzed in IBM Statistical Package for the Social Sciences (SPSS) for Windows for analysis to answer the following research questions:

1. Is there a relationship between the leadership actions of principals and teacher participation in instructional technology professional development?

2. Is there a relationship between professional development taken in instructional technology by teachers and the use of instructional technology integration in the middle school one-to-one classroom?

    a. Does participating in formal teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?

    b. Does participating in informal teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?

c. Does participating in independent teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?

3. Is there a relationship between the leadership actions of principals and the integration of instructional technology in the one-to-one classroom?

4. What are the teacher biases and barriers toward instructional technology and the integration of instructional technology in the one-to-one classroom?

In this chapter, major findings from the analysis in Chapter 4 will be summarized and discussed. Finally, recommendations for policy and practice will be detailed as well as recommendations for further research.

Summary of Findings

Research question 1: Is there a relationship between the leadership actions of principals and teacher participation in instructional technology professional development? This first research question seeks to identify if there are any leadership actions principals take that are more likely to encourage teachers to participate in any of the three forms of professional development.

Finding #1*:* Principals in this study were not reported to have taken a highly active role in creating the conditions necessary for teachers to participate in professional development. When teachers report that they do, their actions have mixed relationships to teachers participating in professional development. Principals were reported to enact the action of *highlights the one-to-one technology professional development taken by staff members to other staff and/or the community* (62.8%) (Table 14) with the greatest frequency. Thus, principals in this study do not frequently demonstrate leadership actions to promote instructional technology

professional development, contraindicating the available research about the effectiveness of these actions (Parr, 1999). This would indicate that the principals in this study are either unaware of these actions or they do not exhibit effective instructional leadership. However, even though teachers report their principals taking the action of *highlights the one-to-one technology professional development taken by staff members to other staff and/or the community* with the highest frequency, there was no statistically significant relationship between this action and teachers taking any form of professional development (Table 16). This too contradicts the research by Frank, Zhao, and Borman (2004), who discuss the importance of change agents allowing teachers time to share their professional development experiences.

Additionally, teachers indicated that their principals use actions that promote formal professional development more than informal or independent professional development. This is represented in Table 16, as four principal actions saw a significant relationship to teacher participation in formal professional development whereas only two principal actions each had a statistically significant relationship to informal and independent professional development. This finding could be the result of several factors including that informal and independent professional development are newer than formal professional development and principals are not as cognizant of these forms or the benefits of these forms of professional development, or they do not believe the learning will be aligned to building and/or district goals and thus, do not encourage teachers to participate in them (Jones & Dexter, 2014). Also, it could be that teachers who participate in informal and independent professional development do so of their own volition because they are life-long learners. Thus, these teachers do not need the action of the principal to participate in these forms of professional development (Ross et al., 2015).

Finding #2*:* When leaders establish trust and encourage teachers to take risks, teachers will participate in instructional technology professional development. Across all types of professional development, formal (τ_b=.142, p<.05), informal (τ_b=.130, p<.05), and independent (τ_b=.169, p<.01), the only leadership action that was significant was, *established trust and encouraged me to take risks in learning something with which I wasn't previously comfortable* (Table 16). This is consistent with the finding that when principals establish trust with their staff, they build high levels of capacity. Therefore, as the literature noted (Youngs & King, 2002), teachers are more willing to participate in instructional technology professional development when they trust their principal. Additionally, the action of *established trust and encouraged me to take risks in learning something with which I wasn't previously comfortable* had the second highest frequency of the leadership actions principals take for encouraging teachers to attend instructional technology professional development (61.9%) (Table 14). This is consistent with the findings of Tschannen-Moran & Gareis (2015), who found that teachers are looking for leaders who are open and approachable with their attitudes regarding instruction.

Research question 2: Is there a relationship between professional development taken in instructional technology by teachers and the use of instructional technology integration in the middle school one-to-one classroom?

a. **Does participating in formal teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?**

b. **Does participating in informal teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?**

c. Does participating in independent teacher professional development correlate with the use of various instructional technologies in the one-to-one classroom?

This research question seeks to determine if there are relationships between instructional technology integration in the one-to-one classroom after teachers participate in each of the forms of professional development. Similarly, relationships between instructional technology integration and teacher participation across all forms of professional development were examined for commonalities.

Finding #3*:* Teachers are more likely to participate in informal professional development on more than ten occasions per year and this is more than the other forms of professional development. Of the teacher respondents, 37.3% reported participating in informal professional development ten or more times, versus 15.1% for formal, and 27.4% for independent (Table 17). This would support the findings that teachers prefer informal professional development because it is ongoing and "just in time" (Granger et al., 2002; Schrum & Levin, 2013). This finding could be because the approval process, cost, and opportunities available for formal professional development encourages teachers to seek alternative means of professional development more frequently.

Finding #4*:* Independent professional development is not utilized by many teachers and this impacts how instructional technology is integrated in the one-to-one classroom. In sum, 20.4% of teacher respondents did not participate in independent professional development at all and 56.2% participated in this form of professional development less than three times per year (Table 17). Although independent professional development happens, "just in time," and provides flexibility in the time in which a teacher can participate, teachers are either unaware of these professional development offerings, don't have the time to participate, don't see the benefit of

participating, disagree with this form of professional development, or districts are not awarding professional development credit for independent professional development activities (Scott & Mouza, 2007). It is also possible that teachers are not comfortable with the technologies needed for them to participate in independent professional development and leaders should focus on exposing their staff to these technologies for greater participation. Furthermore, this lack of participation in independent professional development is highlighted by the finding that there were statistically significant relationships between participation in independent professional development and four integration actions (*performs experiments and analyze information (*τ_b=.251, p<.01), *work collaboratively with their peers* (τ_b=.172, p<.01), *work with peers to problem solve* (τ_b=.197, p<.01), and *incorporate project based learning* (τ_b=.215, p<.01)) (Table 19). Interestingly, each of these integration actions involve collaborative work between students.

Finding #5*:* Formal professional development creates the greatest integration of instructional technology in the one-to-one classroom. In this study, all 11 of the integration actions were found to have a statistically significant relationship with participation in formal professional development, in contrast to six of the 11 actions being statistically significant to participation in informal professional development and four of the 11actions being statistically significant to participation in independent professional development (Table 19).

Currently, formal professional development may be creating the greatest relationship to instructional technology integration because it is still the model used and preferred by most districts for professional development credit and salary advancement for teachers (Penuel, 2006). This may change as teachers become more aware of and comfortable with these new forms of professional development.

Finding #6*:* All types of professional development can assist teachers in some form of instructional technology integration. There was a statistically significant relationship between teachers implementing instructional technology in their classrooms by having students *perform experiments and analyze information* (formal, τ_b=.238, p<.01, informal, τ_b=.251, p<.01, independent, τ_b=.251, p<.01), *work collaboratively with peers* (formal, τ_b=.195, p<.01, informal, τ_b=.179, p<.01, independent, τ_b=.172, p<.01), and *work with peers to problem solve* (formal, τ_b=.186, p<.01, informal, τ_b=.201, p<.01, independent, τ_b=.197, p<.01) and all three forms of professional development (Table 19). This is encouraging as the ISTE Standards for Teachers (2008), describe how teachers should integrate instructional technology through experimentation and analysis, collaboration, and problem solving.

Similarly, across all three forms of professional development, the highest percentage of teachers reported changing their instructional methods by *changing the way they deliver instruction by differentiating and individualizing learning tasks for students (formal=85.3%, informal=80.8%, independent=82.1%)*, *changing the way they delivered content and assessed their students (formal=86%, informal=86%, independent=85.3%),* and *communicate with students, parents, and peers (formal=83.5%, informal=80.4%, independent=80.4%)* (Tables 17, 15, 16). Many of the relationships between technology integration and participation in professional development are statistically significant (Table 19), and teachers integrate instructional technology with high frequency after participating in all three forms of professional development. This is supported in the research by Jones & Dexter (2014), who found a hybrid approach to professional development creates the greatest integration of instructional technology. A hybrid approach to professional development provides content specific, ongoing, "just in time"

professional development that is supported beyond the school or district for teachers to successfully learn to integrate instructional technology (Jones & Dexter, 2014).

Research question 3: Is there a relationship between the leadership actions of principals and the integration of instructional technology in the one-to-one classroom? Similar to research question one, this research question seeks to identify if there are any leadership actions the principal takes that are more likely to encourage teachers to integrate instructional technology in the one-to-one classroom after they participate in any of the three forms of professional development.

Finding #7*:* Teachers reported that principals do not demonstrate leadership actions for increased instructional technology integration with high frequency. The four leadership actions of *highlights successful one-to-one technology integration by staff members to other staff and/or the community*, *established trust and encouraged me to take risks integrating one-to-one technology*, *communicates the goals of the one-to-one technology initiative in my school, and encouraged and provided positive reinforcement for me to integrate one-to-one technology* were identified as actions principals were performing with a frequency greater than 50% (Table 22). While at the same time, the leadership actions of *model how to integrate instructional technology* was identified as being performed by 27% of the respondents, and *worked collaboratively with me to integrate one-to-one technology in my lessons* was identified as being performed by 19% of the respondents (Table 22).

The frequency of these actions should be increased as prior research suggests the leadership actions of modeling the use of technology (Afshari et al., 2012; Villano, 2008) and collaborating with teachers to help them integrate technology in their lessons (Afshari et al., 2012) is important for technology integration. Similarly, the leadership actions of *actively sought the resources I*

needed to integrate one-to-one technology successfully, asked if I needed further one-to-one technology professional development, encouraged me to model how I am integrating one-to-one technology to my peers, and used evaluations to reinforce the importance of one-to-one technology integration in my lessons were also reported with a frequency of less than 50%, and these actions have been proven to establish a positive relationship with instructional technology integration (Levin & Wadmany, 2008; O'Hara, Pritchard, Huang, & Pella, 2013).

It was also found that teachers reported that principals do not perform the action of *worked collaboratively with me to integrate one-to-one technology in my lessons* with great frequency. However, when they did perform this action, there was a statistically significant relationship with moderate strength to *use social media for projects* after teachers participated in both formal and independent professional development (formal, r_{φ}=.319, p<.01; independent, r_{φ}=.344, p<.01) (Table 23.6). It is quite possible that principals do not understand their role as the digital leader, or they are abdicating or delegating this role to the technology coordinator or technology lead teacher (Beytekin, 2014; Ertmer et al., 2002).

Finding #8*:* Reported principal leadership actions show a relationship to teachers integrating instructional technology by *facilitating student collaboration beyond the classroom walls*. There were statistically significant relationships between nine leadership actions and technology integration by *facilitating student collaboration beyond the classroom walls* (Table 27). Several of these statistically significant relationships were either moderate, or just below moderate in strength as indicated by Phi correlation coefficients between .27 and .336.

The data indicates that instructional technology professional development that is taken by teachers, no matter the form, emphasizes the use of instructional technology to facilitate collaboration outside of school. Additionally, this study found that one of the stated visions or

goals of the one-to-one programs is to facilitate student collaboration outside of the classroom walls. This is a positive finding as it reinforces previous research indicating that instructional technology integration should facilitate collaboration outside of school by students (Davidson et al., 2014; ProjectTomorrow, 2010).

Table 27

Leadership actions vs. Facilitates Student Collaboration Beyond the Classroom Walls

Facilitates Student Collaboration Beyond the Classroom Walls			
Leadership Action	**Formal PD Phi (r_φ)**	**Informal PD Phi (r_φ)**	**Independent PD Phi (r_φ)**
Communicates the goals of the one-to-one technology initiative in my school	.285**		
Used evaluations to reinforce the importance of one-to-one technology integration in my lessons	.239**	.166*	.271**
Provided release time to collaborate and plan with other teachers to integrate one-to-one technology in the classroom	.196**		.313**
Asked if I needed further one-to-one technology professional development	.185*		
Actively sought the resources I needed to integrate one-to-one technology successfully	.336**		.225**
Worked collaboratively with me to integrate one-to-one technology in my lessons	.295**	.191**	.318**
Encouraged me to model how I am integrating one-to-one technology to my peers	.310**	.263**	
Encouraged and provided positive reinforcement for me to integrate one-to-one technology	.175*		.191*
Highlights successful one-to-one technology integration by staff members to other staff and/or the community	.177*		.189*

Note: Significance at *p < .05. **p < .01.

Finding #9*:* When teachers reported that principals use evaluations to reinforce the importance of utilizing technology in one-to-one classrooms, there are relationships to teachers integrating technology and using one-to-one devices in their lessons. From Table 23.2, the leadership action of *used evaluations to reinforce the importance of one-to-one technology integration* in my lessons had statistically significant relationships to five integration actions after teachers participated in formal professional development, seven integration actions after teachers participated in informal professional development, and eight integration actions after teachers participated in independent professional development. This result would indicate that teacher respondents will integrate instructional technology if they know they will be evaluated on its use.

However, very little research has been done on the effect of teacher evaluations and technology integration. Those districts that have included instructional technology integration on their observation/evaluation forms often include this metric under the instruction section rather than a separate section to emphasize the importance of instructional technology integration (Whale, 2006). It would be interesting to identify in further research if teachers are more willing to integrate instructional technology if there was a section on annual teacher evaluation rubrics that specifically address various aspects of integrating instructional technology.

Finding #10*:* The reported leadership actions of *modeling one-to-one technology use* and *established trust and encouraged me to take risks integrating one-to-one technology* demonstrated no statistically significant relationships to any of the instructional technology integrations across all three types of professional development. When the Fisher's Exact Test is performed, none of the integration actions asked in the survey were statistically significant for either of these leadership actions. Both of these findings were surprising as previous research

describes the importance of leaders modeling the use of technology to encourage teaches to integrate instructional technology in the classroom (Afshari et al., 2012; Bailey, 1997; Farrell, 2003), as well as the importance of establishing trust and encouraging taking risks (Handford & Leithwood, 2013; Lawson et al., 2017; McLeod, 2015; Sheninger, 2014).

What was equally interesting in this finding is that e*stablished trust and encouraged me to take risks integrating one-to-one technology* was found to be statistically significant to teachers participating in all three forms of professional development as noted in finding number two. Perhaps if the question were separated into two separate questions, one that asked about trust and one that asked about encouraging teachers to take risks, a relationship may have been found.

Research question 4: What are the teacher biases and barriers toward instructional technology and the integration of instructional technology in the one-to-one classroom? This purpose of this research question is to determine the identified barriers and biases to instructional technology integration in the one-to-one classroom, as well as general teacher beliefs about one-to-one initiatives in general. Although there are many studies reporting instructional barriers and biases to instructional technology integration in general, there is a gap in the literature concerning these in one-to-one classrooms.

Finding #11*:* Time is the number one barrier to instructional technology integration in the one-to-one classroom, as well as an established belief of need for integration of one-to-one devices in the classroom. Supporting this finding, 154 teacher respondents (58.8%) reported time to plan as a barrier, 153 (58.4%) reported time to collaborate with peers as a barrier, 145 (55.3%) reported time to learn and experiment as a barrier, and 121 (46.2%) reported a lack of time because of outside factors as a barrier (Table 24). Further supporting this finding are teacher respondent beliefs. Specifically, the identified beliefs of *I believe time to plan is important for*

instructional technology integration (Mean=4.61), the belief of *I believe time to collaborate is important for instructional technology integration* (Mean=4.58), *and I believe time to learn new instructional technologies is important for technology integration* (Mean=4.65) (Table 25) reinforce this finding.

These results are similar to previous studies which also reported time as the number one barrier to instructional technology as well as the belief that if teachers had more time, they would integrate instructional technology more and with better efficacy (Holland, 2001; Machado & Chung, 2015; Pritchett et al., 2013; Skues & Cunningham, 2013; Zhao & Frank, 2003). How time is utilized and structured both during the school day and after the school day should be examined for greater efficiencies. Thus, addressing the barrier of time should be the number one priority for administrators and teachers, especially when a one-to-one initiative is being implemented.

Finding #12*:* When leaders provide the one-to-one technology vision and teachers understanding this vision, one-to-one implementations are more successful. The leadership action of *communicates the goals of the one-to-one initiative* shows statistically significant relationships to various forms of instructional technology (Table 23.1). Teachers in this sample also indicated that they *understand (Mean = 3.89) and support (Mean = 3.91) the one-to-one vision* in their district (Table 26). This indicates that when a principal communicates the vision and goals of the one-to-one initiative, the majority of these teachers were willing to buy into the one-to-one initiative and possibly increase the chance for a successful one-to-one implementation. This is confirmed in previous research that has found the importance of stating the vision as an important leadership action that creates buy-in to change and instructional technology integration (Chang et al., 2008; McLeod, 2015; Sheninger, 2014).

Finding #13*:* Even in schools with one-to-one initiatives, teachers are undecided about the overall benefit to students having a one-to-one device at all times of the day. Even though teachers indicated they *understood (Mean = 3.89) and supported (Mean =3.91) the vision of the one-to-one initiative*, and that they believed one-to-one environments *have the ability to positively increase student achievement and impact learning* (Mean = 4.17), many respondents also indicated they *don't believe students should have a device at all times of the day for instruction* (Mean = 3.25, Mode = 2.0) (Table 26). This is similar to findings by Downes & Bishop (2015), who indicated that as teachers confront students who are more skilled with technology, they will be challenged to change their pedagogy and beliefs. However, the ramification of this belief is that it could indicate how teachers will implement the one-to-one device, or that they do not know what to do with the device. Similarly, it is unclear if this belief is due to a lack of a belief that one-to-one devices are good pedagogy or if it's the choice of device that creates this belief. Whatever the cause, caution is required as this belief could in turn become a barrier to integration of the one-to-one technology.

Finding #14*:* Professional development is rarely seen as a barrier for teachers in one-to-one environments. Professional development was only reported as a barrier to the integration of instructional technology by 45 (17.2%) of the respondents (Table 24). This most likely indicates that districts that implement one-to-one initiatives understand the need to change teacher beliefs about instructional technology integration through professional development (Ertmer, 2005; Hixon & Buckenmeyer, 2009; Levin & Wadmany, 2008). Similarly, it could be a public relations problem if these devices were not used for instruction after being touted as a tool for increased student achievement and engagement (Cuban, 2001).

What is also striking about this finding is that teachers in this study believed that if they attended professional development, there would be adequate support (Mean = 3.80) and resources (Mean = 3.80) for them to integrate technology in their one-to-one classrooms (Table 25). Again, this finding is in alignment to prior studies indicating the necessity of support and resources for instructional technology integration (Brinkerhoff, 2006; Ertmer, 1999; Hew & Brush, 2007). Thus, the findings in this study continue to indicate the importance of professional development, support, and resources for teachers to integrate instructional technology in their lessons.

Recommendations for Policy

Recommendation #1: Teachers should be encouraged to attend a variety of forms of professional development (formal, informal and independent) to learn how to integrate instructional technology in the classroom. As it was found that teachers participate in all three forms of professional development with varying degrees of relationships to the integration of technology, it is important that teachers experience self-directed learning as well as formalized, intentional professional development. Jones & Dexter (2014) recommended a hybrid approach to professional development and the same recommendation can be made from the analysis in this study.

Table 19 presents the statistically significant relationships between each of the forms of professional development and teachers' integration of instructional technology. From this table, it is shown that there are statistically significant relationships to all of the integration actions and teachers' participating in formal professional development. However, there were also statistically significant relationships between informal and independent professional development and several of the integration actions as well. Thus, the importance of informal and independent professional development cannot be diminished. Teachers desire "just in time" professional development and

informal and independent professional development allow for "just-in-time," learning (Hixon & Buckenmeyer, 2009). Therefore, to move teachers toward participating in more informal and independent professional development, it is recommended that districts and/or district professional development committees award professional development credit for participation in all three forms of professional development, and not just formal professional development.

Recommendation #2: Certification agencies could embed instructional technology professional development as a requirement for continued certification renewal for teachers. There were statistically significant relationships between participation in professional development and the integration of instructional technology (Table 19). To encourage teachers to learn how to integrate instructional technology into their content and pedagogy, certification agencies might consider requiring a specific number of hours in instructional technology and instructional technology integration for teachers to maintain their certification. New York State recently revised certification renewal and continues to do so in cooperation with New York State United Teachers and the Board of Regents. Just as certain teachers and administrators in New York now need a certain percentage of their continuing teacher and leader education (CTLE) hours to be in the area of English as a New Language (ENL), so too should there be a requirement for a set percentage for instructional technology integration hours (NYSED, 2016b).

Recommendation #3: Professional development credit could be awarded upon demonstrated proficiency of teacher learning through evidence of implementing what they learned in the classroom. As was stated previously, there are relationships between the formal, informal, and independent professional development and instructional technology integration (Table 19). Therefore, it is recommended that state certification agencies, along with various stakeholder groups, make instructional technology integration professional development a

component of continued certification. However, it is also important that teachers demonstrate understanding and application of what they have learned. To this end, districts can structure time for professional development in combination with set teacher expectations for instructional technology integration.

In Wisconsin and other parts of the country, teachers can only receive professional development credit once they submit evidence of the application of what they have learned in their classrooms. This is known as micro-credentialing (Schwartz, 2017). "Micro-credentials offer teachers great flexibility to individualize and learn at their own time and pace, supporting the opportunity to intentionally implement new learning in their classrooms…and provide opportunity for feedback" (Crow, 2017). Although the cost of micro-credentialing could be great, this opens a new frontier into ensuring teachers participate in professional development that is "just in time," and requires them to use what they have learned in the classroom (Hixon & Buckenmeyer, 2009).

Recommendation #4: Leadership preparation programs could include a class on leadership actions for encouraging professional development and instructional technology integration and/or incorporated into a course on instructional leadership. As was evidenced in this study, several leadership actions have a statistically significant relationship to teachers attending various forms of professional development (Table 16), as well as teachers' willingness to integrate instructional technology (Tables 23.1-23.6, 23.8, 23.9, 23.11). The principal action of *establishing trust and encouraging teachers to take risks* had a statistically significant relationship to teachers participating in all three forms of professional development (Table 16). This is consistent with the findings of Dawson and Rakes (2003), who reported finding schools whose principal received technology integration training had higher levels of technology integration success. Additionally, when leaders make the vision and goals of the one-to-one initiative explicit

(Table 23.1), they can change teacher beliefs and remove barriers for instructional technology integration in the one-to-one classroom (Afshari et al., 2012; Chang et al., 2008).

Similarly, there were leadership actions that teachers reported their principals taking, but which have no or little significance to teachers attending professional development or integrating instructional technology. As an example, teachers reported that principals utilized the leadership actions of *highlights the one-to-one technology professional development taken by staff members to other staff and/or the community*, yet there were no statistically significant relationships to teachers participating in any of the forms of professional development.

Thus, if principals wish to effectively encourage teachers to participate in professional development and integrate technology in the one-to-one classroom, they must learn, be cognizant of, and practice the leadership actions that provide the greatest return on investment in relation to professional development and instructional technology integration (Tables 13, 21).

Recommendations for Practice

Recommendation #1: Principals should promote and make a compelling case for teacher participation in all three forms of professional development with more frequency. While formal professional development continues to be encouraged by principals, it remains important that principals encourage professional development in the form of informal and independent more frequently (Table 17). Similarly, when teachers participated in independent professional development, there were statistically significant relationships to integration actions that promote collaborative work for students (Table 19).

Additionally, informal and independent professional development are relatively new to the education community and are growing in frequency and preference by teachers (Ross et al., 2015).

As technology affords teachers the ability to learn from professionals across the country and the world in an asynchronous environment, it is important that leaders tap into a teacher's willingness to participate in these forms of learning and participate in this type of learning themselves (Vavasseur & MacGregor, 2008). This is reinforced by Jones and Dexter (2014), who advocate for a hybrid approach to professional development for technology integration.

Recommendation #2: Principals should provide common planning time in teacher schedules for planning and collaboration on instructional technology integration. Time was identified by teacher respondents in this study as both a belief and a barrier to instructional technology integration (Tables 23, 24). As time has been consistently found to be the major barrier to technology integration (Pritchett et al., 2013; Skues & Cunningham, 2013; Windschitl & Sahl, 2002), and this study's findings are no different, it is important that principals make every effort to provide common time for planning, collaboration, and time to learn new technologies. It also sends the message that instructional technology integration is a goal of the district and that there will be resources devoted to ensuring this goal can be achieved (Bernhardt, 2013). However, caution is recommended that principals ensure that time is the barrier to integration and not reluctance to pedagogical change.

Recommendation #3: Principals should work collaboratively with teachers to support them in integrating instructional technology for the purpose of engaging all learners. As the principal is the first line of administrative support for teachers, they need to work alongside the teachers to help them with technology integration. When the principal *worked collaboratively with the teachers*, there were statistically significant relationships to five integration actions after a teacher participated in formal professional development, three integration actions after participating in informal professional development, and five integration actions after participating

in independent professional development. Three of these integration actions are statistically significant across all three forms of professional development (Table 28). This would indicate that teachers will integrate technology using social media for projects, facilitate student collaboration beyond the classroom walls, and differentiate learning tasks when the principal works with them. These integration actions move the teacher from being, "the sage on the stage to the guide on the side," thus allowing for greater student engagement in the lessons. This aligns with the findings that teachers attend professional development to learn how to increase student engagement (U.S. Department of Education, 2016).

Similarly, the teacher respondents in this study believed they were supported (mean=3.80) by their principal leaders, further indicating that teachers believe principal support is essential to instructional technology integration (Table 25).

Table 28

Worked collaboratively with me to integrate one-to-one technology and teacher integration

	Worked collaboratively with me to integrate one-to-one technology in my lessons
Type of PD	**Integration**
Formal	Perform experiments and analyze information
	Use social media for projects
	Facilitate student collaboration beyond the classroom walls
	Differentiated learning task for individual students
	Allow students options for demonstrating understanding of a topic
Informal	Use social media for projects
	Facilitate student collaboration beyond the classroom walls
	Allow students options for demonstrating understanding of a topic
Independent	Use social media for projects
	Facilitate student collaboration beyond the classroom walls
	Differentiated learning task for individual students
	Incorporate project-based learning
	Allow students options for demonstrating understanding of a topic

Recommendation #4: School districts should discuss how instructional technology integration can be incorporated in their teacher observation reports. It makes sense that staff understand and become part of the process in determining how they will be evaluated using instructional technology in their classrooms. Similarly, principals should be involved in these discussions and adhere to the agreed upon rubric by looking for instructional technology integration, reporting it, and providing feedback to the teacher. Through evaluations, teachers can be held accountable for integrating the one-to-one device. When teachers understand what is expected of them, they will be more likely to implement what they learned in professional development (Ertmer, 2005). As reported in the findings, relationships existed between *used evaluations to reinforce the importance of one-to-one technology integration in my lessons* and five integration actions after teachers participated in formal professional development, seven integration actions after teachers participated in informal professional development, and eight integration actions after teachers participated in independent professional development. Five of these integration actions are statistically significant across all three forms of professional development (Table 23.2). These five integration actions (*perform experiments and analyze information, use social media for projects, create and deliver digital presentations, facilitate student collaboration beyond the classroom walls*, and *incorporate project-based learning*) are all related to student engagement and hands-on learning.

Little has been researched and/or written concerning the relationship between teacher observations and instructional technology integration. However, some districts have modified their teacher observation reports to include instructional technology integration (Whale, 2006). However, this is usually optional for leaders to evaluate because of competing district goals, and thus, teachers may or may not integrate technology during an observation. When observing and

performing instructional technology integration becomes optional, integration is not reinforced as a priority or goal for teachers in one-to-one schools. This is similar to the phrase, "What gets tested, gets taught" (Diamond, 2007).

Recommendation #5: Principals need to clearly articulate the one-to-one vision and articulate the benefits of this initiative. The literature is in agreement that articulating a vision is a necessary leadership action (Chang et al., 2008; M. Golden, 2004; McLeod, 2015). Additionally, the results of this study indicate the leadership action of *communicates the goals of the one-to-one technology initiative in my school* showed statistically significant relationships to four integration actions after teachers participated in formal professional development and two integration actions after they participated in informal professional development (Table 23.1). Likewise, teachers reported they both understood and supported the vision of the one-to-one initiatives in their schools (Table 26). When this happens, the chance for a successful one-to-one implementation increases (Herold, 2016; McLeod, 2015).

This becomes increasingly important when one looks at additional results from this study. Although teachers understand and support the one-to-one visions in their schools, many of the teacher respondents also indicated their lack of belief in the idea that all students should have a device at all times of the day for instruction (Table 26). Somehow, there is a disconnect between the leadership action of articulating the vision and teachers understanding the vision, and teachers believing students should have these devices at all times of the day for instruction. The reason for this paradox is unclear. However, this finding is described further in the recommendations for further study in the following section.

Recommendations for Further Study

Recommendation #1: Expand this study to a larger population. This study could be expanded to include all of Long Island, other regions of New York State, the whole state, or the nation. This study examined 12 Long Island districts that were representative of New York State (NYSED, 2015a). Although it represents a fair sampling, the data would be interesting to compare to a larger sample or a sample from other regions of the same state. This study could also be done longitudinally at one, three, and five years, as the number of districts implementing one-to-one initiatives is increasing each year (Zheng et al., 2016).

Recommendation #2: Replicate this study using elementary or high school teachers as the population. Although this study examined middle school teachers, it would be interesting to determine if similar findings are obtained with these other two populations. Elementary schools would be a unique environment in that the students stay with the same teacher for most of the day whereas middle school students tend to change classes. Would elementary teachers who have the same students for a longer duration be more willing to integrate the technology than their middle school counterparts? High schools will be an equally interesting environment in that the students the teachers are departmentalized and it could be interesting to see if certain departments are more likely to integrate instructional technology than others.

Recommendation #3: Replicate this study using interviews of teachers and/or principals in lieu of surveys. Instead of performing this research quantitatively, it could be performed qualitatively by interviewing middle school teachers/principals and high school teachers/principals to collect more in-depth responses.

Recommendation #4: Replicate this study using principals as the sample and compare their results to those of the teachers in their buildings. It would be interesting to see if the leadership actions teachers report are similar to self-evaluation of leadership actions by the

principals in these schools. Similarly, it would be of interest to see if the same statistically significant relationships exist after analyzing principal responses.

Finally, it would be of interest to see what barriers principals see for instructional technology integration and analyze if their beliefs about instructional technology integration and one-to-one initiatives matches those of the teachers in their buildings. Specifically, do principals have the same opinion as teachers about students having a device at all times of the day?

Recommendation #5: Study the effect of evaluations on instructional technology integration. As there is little, to no research, in the area of how teacher evaluations effect the integration of instructional technology, it would seem apparent that this could be an area for future research. From this study alone, the leadership action of *used evaluations to reinforce the importance of one-to-one technology integration in my lessons* showed statistically significant relationships to several integration actions independent of the type of professional development in which a teacher participates. As more districts add the use of instructional technology to teacher observations, it would be of interest to see if a relationship exists between the teacher observation process and the level of instructional technology integration in the one-to-one classroom (Whale, 2006).

Recommendation #6: Investigate under what conditions and why teachers prefer informal and/or independent professional development. This study did not examine why teachers participate in informal and independent professional development. This study also did not investigate why they prefer informal and independent professional development. Finally, it would also be worthwhile to examine if informal and independent professional development are preferred by teachers for specific technology integrations.

Although formal professional development is offered and reinforced through fulfillment of contractual obligations and salary advancement, it would be interesting to examine the reasons teachers attend and participate in formal and independent professional development (Lawless & Pellegrino, 2007). This research could then be used to help inform district professional development committees in their professional development offerings and the subsequent award of credit for participation in these forms of professional development.

Recommendation #7: Investigate the variables that contribute to teachers' lack of agreement that students should have a one-to-one device with them at all times of the day for instruction. To understand why teachers continue to believe students shouldn't have a one-to-one device at all times of the day for learning even though they are currently teaching in a one-to-one setting, other variables in combination with articulating the vision should be examined. In this study, it was found that teachers understood the one-to-one vision and supported it, but they also indicated being unsure about students having the devices at all times of the day for instruction (Table 26). It is possible that teachers believe the devices are a distraction to learning. It could also be that teachers believe there is educational and social detachment during class when the devices are present. Finally, it could be that teachers don't believe utilizing technology is good pedagogy or that the device choice is not suitable to their desired goals or outcomes. Whatever variables may exist, it would be helpful to understand these variables as these variables could become barriers to instructional technology integration themselves.

Summary/Conclusions

One-to-one environments provide a unique learning environment for students with the stated goals of most initiatives being increased student achievement and engagement (Downes & Bishop, 2015; Keengwe & Onchwari, 2009; Penuel, 2006). The key to achieving success in the

one-to-one setting often relies on the successful integration of technology and this is most often accomplished through professional development in a variety of forms with support and encouragement from the building leader (Hew & Brush, 2007; Shuldman, 2004).

Findings in this study identified relationships between specific leadership actions and teacher participation in professional development and teacher integration of instructional technology in the one-to-one classroom. However, in terms of both teacher participation in professional development and teacher integration of instructional technology, these leadership actions were performed with a relatively low frequency. Similarly, there were some actions that did not yield any relationships to teachers participating in instructional technology professional development or the integration of technology in the one-to-one classroom.

There were also relationships identified between the form of professional development in which a teacher participated and the integration of instructional technology in the classroom. Although formal professional development remains the most frequently attended form of professional development for instructional technology integration, as well as the most supported form by districts, teachers are beginning to participate in informal and independent professional development with some frequency (Table 17).

Lastly, teachers reported their beliefs concerning instructional technology and one-to-one environments and they identified barriers to integrating instructional technology. The importance of time, or the lack thereof, as both a belief and barrier cannot be underestimated. The literature on this is conclusive and yet it continues to be the most identified barrier to instructional technology integration (Lu & Overbaugh, 2009; Pritchett et al., 2013; Windschitl & Sahl, 2002).

As one-to-one initiatives are continuing to increase in New York because of the Smart Schools Bond Act (NYSED, 2015b), it becomes ever more important that principals continue to lead, participate in, and encourage teachers to participate in a variety of forms of professional development. Additionally, principals must also be active participants in encouraging teachers to integrate instructional technology in their lessons and they must provide the resources, time, and support to overcome barriers and address teacher beliefs about the integration of one-to-one devices into their lessons. One-to-one initiatives hold great promise for the future, but they will require skilled digital leadership and teachers' participation in a variety of forms of professional development for teachers to willingly integrate instructional technology into both their content and pedagogy for these initiatives to be successful.

References

Abell Foundation. (2008). *One-to-one computing in public schools: lessons from "Laptops for All" programs*. *Abell Foundation*. Abell Foundation.

Afshari, M., Bakar, K. A., Luan, W. S., & Siraj, S. (2012). Factors affecting the transformational leadership role of principals in implementing ICT in schools. *Turkish Online Journal of Educational Technology*, *11*(4), 164–176.

Anderson, R. E., & Dexter, S. (2005). School technology leadership: An empirical investigation of prevalence and effect. *Educational Administration Quarterly*, *41*(1), 49–82.

Anderson, R. E., Dexter, S. L., Center for Research on Information Technology and Organizations CA., I., & Minnesota Univ., M. (2000). *School technology leadership: incidence and impact. Teaching, learning, and computing: 1998 national survey, report #6.*

Ardichvili, A., Page, V., & Wentling, T. (2003). Motivation and barriers to participation in virtual knowledge-sharing communities of practice. *Journal of Knowledge Management*. Kempston: MCB UP Ltd. https://doi.org/10.1108/13673270310463626

Bailey, G. D. (1997). What technology leaders need to know: The essential top 10 concepts for technology integration in the 21st Century. *Learning & Leading with Technology*, *25*(1), 57–62.

Barth, R. S. (1986). On sheep and goats and school reform. *Phi Delta Kappan*. Bloomington: Phi Delta Kappa.

Beach, R. (2012). Can online learning communities foster professional development? *Language Arts*. Urbana: National Council of Teachers of English.

Bebell, D., & Kay, R. (2010). One to one computing: A summary of the quantitative results from the Berkshire wireless learning initiative. *Journal of Technology, Learning, and Assessment*, *9*(2).

Bebell, D., & O'Dwyer, L. M. (2010). Educational outcomes and research from 1:1 computing settings. *Journal of Technology, Learning, and Assessment*, *9*(1).

Bennis, W. (2009). *On becoming a leader* (Twentieth). New York: Perseus Books Group.

Bernhardt, V. L. (2013). *Data analysis for continuous school improvement* (1st ed.). New York, NY: Taylor & Francis.

Beytekin, O. F. (2014). High school administrators perceptions of their technology leadership preparedness. *Educational Research and Reviews*, *9*(14), 441–446.

Blankenship, S. S., & Ruona, W. E. A. (2007). *Professional Learning Communities and Communities of Practice: A Comparison of Models, Literature Review*. *Online Submission*. Online Submission.

Bolluyt, J. (2016). iPad vs. Chromebook? 5 Reasons to Buy a Chromebook. Retrieved March 14, 2017, from http://www.cheatsheet.com/gear-style/ipad-vs-chromebook-5-reasons-to-buy-a-chromebook.html/?a=viewall

Bono, J. E., Hooper, A. C., & Yoon, D. J. (2012). Impact of rater personality on transformational and transactional leadership ratings. *The Leadership Quarterly*. Oxford: Elsevier B.V. https://doi.org/10.1016/j.leaqua.2011.11.011

Bridges, W. (2009). *Managing transitions* (3rd ed.). Philadelphia: Da Capo Press.

Brinkerhoff, J. (2006). Effects of a long-duration, professional development academy on

technology skills, computer self-efficacy, and technology integration beliefs and practices. *Journal of Research on Technology in Education*, *39*(1), 22–43.

Brown, J. S., & Duguid, P. (1991). Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovating. *Organization Science*, *2*(1), 40–57.

Burns, J. M. (1978). *Leadership* (Vol. 1st). BOOK, New York: Harper & Row.

Butler-Pascoe, M. E., & Wiburg, K. (2003). *Technology and teaching english language learners*. New York, NY: Allyn & Bacon.

Casserly, M., Jepson, J., Williams, A., Lewis, S., & Council of the Great City Schools DC., W. (2000). *Adequate state financing of urban schools: An analysis of state funding of the New York City public schools.*

Caynon, W. (1982). Collective bargaining and professional development of academic librarians. *College & Researcg Libraries*, *43*(2), 133–139.

Chang, I.-H. (2012). The effect of principals' technological leadership on teachers' technological literacy and teaching effectiveness in taiwanese elementary schools. *Educational Technology & Society*, *15*(2), 328–340.

Chang, I.-H., Chin, J. M., & Hsu, C.-M. (2008). Teachers' perceptions of the dimensions and implementation of technology leadership of principals in Taiwanese elementary schools. *Educational Technology & Society*, *11*(4), 229–245.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd ed.)*. New York, NY: Psychology Press.

Creswell, J. W. (2015). *Educational research: Planning, conducting and evaluating quantitative and qualitative research* (Fifth). Upper Saddle River, NJ: Pearson Education.

Crow, T. (2017). *Micro-credentials for impact: Holding professional learning to high standards*. Oxford, OH.

Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, Ma: Harvard University Press.

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

Daly, A. J. (2015). *Social network theory and educational change*. (A. J. Daly, Ed.) (2nd ed.). Cambridge: Harvard Education Press.

Davidson, L. Y. J., Richardson, M., & Jones, D. (2014). Teachers' perspective on using technology as an instructional tool. *Research in Higher Education Journal*, *24*, 1–25.

Davis, N., Preston, C., & Sahin, I. (2009). Training teachers to use new technologies impacts multiple ecologies: Evidence from a national initiative. *British Journal of Educational Technology*, *40*(5), 861–878.

Dawson, C., & Rakes, G. C. (2003). The influence of principals' technology training on the integration of technology into schools. *Journal of Research on Technology in Education*, *36*, 29+.

Dawson, K. (2012). Using action research projects to examine teacher technology integration practices. *Journal of Digital Learning in Teacher Education*, *28*(3), 117–124.

Dawson, K., Cavanaugh, C., & Ritzhaupt, A. D. (2008). Florida's EETT leveraging laptops initiative and its impact on teaching practices. *Journal of Research on Technology in Education*, *41*(2), 143–159.

de Vries, A., & Meys, J. (2015). *R for dummies* (2nd ed.). Hoboken, NJ: J Wiley & Sons.

Dede, C. (2006). *Online professional development for teachers: Emerging models and methods*. Cambridge, Ma: Harvard Education Press.

Dexter, S. (2011). School_technology_leadership__.PDF. *The Journal of School Leadership*, *21*(2), 166–189.

Dexter, S. L. (2011). School technology leadership: Artifacts in systems of practice. *Journal of School Leadership*, *21*(2), 166–189.

Dexter, S. L., Anderson, R. E., & Ronnkvist, A. M. (2002). Quality technology support: What is it? Who has it? and What difference does it make? *Journal of Educational Computing Research*, *26*(3), 265–285.

Diamond, J. B. (2007). Where the Rubber Meets the Road: Rethinking the Connection Between High-Stakes Testing Policy and Classroom Instruction. *Sociology of Education*, *80*(4), 285–313.

Dias, P. (1999). *Web-based learning communities. Paper presented at the annual meeting of the Conferencia Internacional Challenges*. Braga, Portugal.

Donovan, L., Green, T., & Hartley, K. (2010). An examination of one-to-one computing in the middle school: Does increased access bring about increased student engagement? *Journal of Educational Computing Research*, *42*(4), 423–441.

Dorfman, J. (2016). Music teachers experiences in one-to-one computing environments. *Journal of Research in Music Education*, *64*(2), 159–178. https://doi.org/10.1177/0022429416649947

Downes, J. M., & Bishop, P. A. (2015). The intersection between 1:1 laptop implementation and the characteristics of effective middle level schools. *RMLE Online: Research in Middle Level Education*, *38*(7).

Dufour, R. (2004). Schools as learning communities. *Educational Leadership*, *61*(8), 6–11.

Dufour, R., & Eacker, R. (1998). *Professional learning communities at work: Best practices for enhancing student achievement.* Alexandria, Va: Association for Supervision and Curriculum Development.

Duhaney, D. C. (2001). Teacher education: Preparing teachers to integrate technology. *International Journal of Instructional Media*, *28*, 23.

Dunleavy, M., Dexter, S., & Heinecke, W. F. (2007). What added value does a 1:1 student to laptop ratio bring to technology-supported teaching and learning? *Journal of Computer Assisted Learning*, *23*(5), 440–452.

Duran, M., Runvand, S., & Fossum, P. R. (2009). Preparing science teachers to teach with technology: Exploring a K-16 networked learning community approach. *Turkish Online Journal of Educational Technology - TOJET*, *8*(4), 21–42.

Edutopia Staff. (2007). What is successful technology integration? *Edutopia*.

Edwards, P. L. (1998). Education and technology: Reflections on computing in Ccassrooms. *American Secondary Education*. Bowling Green: Ashland University.

Elmore, R. F. (2000). *Building a new structure for school leadership*. (The Albert Shanker Institute, Ed.). Washington, D.C.

Ely, D. P. (1999). *New perspectives on the implementation of educational technology innovations.*

Ertmer, P. A. (1999). Addressing first and second order barriers to change: Strategies for technology integration. *Educational Technology Research and Development*, *47*(4), 47–61.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development*, *53*(4), 25–40.

Ertmer, P. A., Bai, H., Dong, C., Khalil, M., Park, S. H., & Wang, L. (2002). *Online professional development: Building administrators' capacity for technology leadership.*

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*, *42*(3), 255–284.

eschool News Staff Reports. (2006, December 20). One-to-one computing: Promising solution—or overhyped mistake? *ESchool News*.

Farrell, G. (2003). *Leadership lessons from comprehensive school reforms*. (J. Murphy & A. Datnow, Eds.), *Reference and Research Book News* (Vol. 18). Portland: Corwin Press, Inc.

Fisher's exact test in SPSS Statistics | Laerd Statistics Premium. (2016). Retrieved February 11, 2017, from https://statistics.laerd.com/premium/spss/fet2x2/fishers-exact-test-in-spss.php

Fox, C. (2007). Professional development: From technophobes to tech believers. *T.H.E. Journal*, *34*(7), 36–37.

Franciosi, S. (2012). Transformational leadership for education in a digital culture. *Digital Culture Education*, *4*(2), 235–247.

Frank, K. A., Zhao, Y., & Borman, K. (2004). Social capital and the diffusion of innovations within organizations: The case of computer technology in schools. *Sociology of Education*, *77*(2), 148.

Frederick, G. R., Schweizer, H., & Lowe, R. (2006). After the in-service course challenges of technology integration. *Computers in the Schools*, *23*(1–2), 73–84.

Fryrear, A. (2015). What's a good survey response rate? Retrieved December 12, 2016, from https://www.surveygizmo.com/survey-blog/survey-response-rates/

Fullan, M. (2008). *The six secrets of change*. San Francisco, CA: Jossey-Bass.

Galvis, H. A. (2012). Understanding beliefs, teachers' beliefs and their impact on the use of computer technology. *PROFILE: Issues in Teachers' Professional Development*, *14*(2), 95–112.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, *38*(4), 915–945.

Garthwait, A., & Weller, H. G. (2005). A Year in the life: Two seventh grade teachers implement one-to-one computing. *Journal of Research on Technology in Education*, *37*(4), 361–377.

Gerard, L. F., Bowyer, J. B., & Linn, M. C. (2010). How does a community of principals develop leadership for technology-enhanced science? *Journal of School Leadership*, *20*(2),

145–183.

Gilakjani, A. P. (2013). Factors contributing to teachers' use of computer technology in the classroom. *Universal Journal of Educational Research*, *1*(3), 262–267.

Glazer, E., Hannafin, M., Polly, D., & Rich, P. (2009). Factors and interactions influencing technology integration during situated professional development in an elementary school. *Computers in the Schools*, *26*(1), 21–39.

Glazer, E., Hannafin, M., & Song, L. (2005). Promoting technology integration through collaborative apprenticeship. *Educational Technology Research and Development*, *53*(4), 57–68.

Golden, L. (1997). The secondary school assistant principal as education leader: The New York City experience. *NASSP Bulletin*, *81*(588), 100–105.

Golden, M. (2004). Technology's potential, promise for enhancing student learning. *T.H.E. Journal*, *31*(12), 42.

Granger, C. A., Morbey, M. L., Lotherington, H., Owston, R. D., & Wideman, H. H. (2002). Factors contributing to teachers' successful implementation of IT. *Journal of Computer Assisted Learning*, *18*(4), 480–488.

Gravelle, P. B. (2003). *The Maine learning technology initiative: Impact on the digital divide*.

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

Hallinger, P., & Heck, R. H. (1996). Reassessing the principal's role in school effectiveness. *Educational Administration Quarterly*, *32*(1), 5–44.

Hammond, M., Reynolds, L., & Ingram, J. (2011). How and why do student teachers use ICT? *Journal of Computer Assisted Learning*, *27*(3), 191–203.

Handford, V., & Leithwood, K. (2013). Why teachers trust school leaders. *Journal of Educational Administration*. Armidale: Emerald Group Publishing Limited. https://doi.org/10.1108/09578231311304706

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers ' technological pedagogical content knowledge and learning activity types : Curriculum-based technology integration reframed. *Journal of Research on Technology in Education*, *41*(4), 393–416. https://doi.org/10.1207/s15326985ep2803_7

Hayes, J., & Greaves, T. W. (2013). 1-to-1 computing: Project RED's tools for success. *T.H.E. Journal*, *40*(5), 25–29.

Herold, B. (2016, February 5). Technology in education: An overview. *Education Week*, p. 1. Bethesda, MD.

Herold, B., & Kazi, J. (2016, August 30). Maine 1-to-1 computing initiative under microscope. *Education Week*, p. 2. Bethesda, MD.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educational Technology Research and Development*, *55*(3), 223–252.

Hew, K. F., & Hara, N. (2007). Empirical study of motivators and barriers of teacher online knowledge sharing. *Educational Technology Research and Development*, *55*(6), 573–595.

Hiebert, J., & Others, A. (1996). Problem solving as a basis for reform in curriculum and

instruction: The case of mathematics. *Educational Researcher*, *25*(4), 12–21.

Hixon, E., & Buckenmeyer, J. (2009). Revisiting technology integration in schools: Implications for professional development. *Computers in the Schools*, *26*(2), 130–146.

Hokanson, B., Hooper, S., & The Association for Educational Communications and Technology, W. (2004). *Integrating technology in classrooms: We have met the enemy and he is us. Association for Educational Communications and Technology*. Association for Educational Communications and Technology.

Holland, P. E. (2001). Professional development in technology: Catalyst for school reform. *Journal of Technology and Teacher Education*. Association for the Advancement of Computing in Education (AACE).

Hu, W. (2007, May 4). Seeing no progress, some schools drop laptops. *The New York Times*, p. 1. New York.

Hur, J. W., & Brush, T. A. (2009). Teacher participation in online communities: Why do teachers want to participate in self-generated online communities of K-12 teachers? *Journal of Research on Technology in Education*, *41*(3), 279–303.

Hur, J. W., & Oh, J. (2012). Learning, engagement, and technology: Middle school students' three-year experience in pervasive technology environments in South Korea. *Journal of Educational Computing Research*, *46*(3), 295–312.

ISTE. (2008). ISTE standards for teachers.

ISTE. (2009). ISTE standards for administrators.

Jones, W. M., & Dexter, S. (2014). How teachers learn: The roles of formal, informal, and

independent learning. *Educational Technology Research and Development*, *62*(3), 367–384.

Kabilan, M. K., Adlina, W. F. W., & Embi, M. A. (2011). Online collaboration of English language teachers for meaningful professional development experiences. *English Teaching U6 - ctx_ver=Z39.88-2004&ctx_enc=info%3Aofi%2Fenc%3AUTF-8&rfr_id=info%3Asid%2Fsummon.serialssolutions.com&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.genre=article&rft.atitle=Online+collaboration+of+English+language+teachers+fo*. Hamilton: University of Waikato, Department of English.

Keengwe, J., & Onchwari, G. (2009). Technology and early childhood education: A technology integration professional development model for practicing teachers. *Early Childhood Education Journal*, *37*(3), 209–218.

Keengwe, J., & Schnellert, G. (2012). Digital technology integration in American public schools. *International Journal of Information and Communication Technology Education (IJICTE)*. Hershey: IGI Global. https://doi.org/10.4018/jicte.2012070105

Keengwe, J., Schnellert, G., & Mills, C. (2011). Laptop initiative: Impact on instructional technology integration and student learning. *Education and Information Technologies*. Boston: Springer US. https://doi.org/10.1007/s10639-010-9150-8

Kennewell, S., Parkinson, J., & Tanner, H. (2002). *Developing the ICT capable school*. Florence, US: Routledge.

Killion, J. (2011). The changing face of professional development. *Edge: The Latest Information for the Education Practitioner*, *6*(5), 3–19.

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge

(TPACK)? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60–70. https://doi.org/10.1016/j.compedu.2010.07.009

Koehler, M., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *Journal of Education*, *193*(3), 13–19.

Kotter, J. P. (2012). *Leading change*. Boston: Harvard Business Review.

Kubitskey, B. W., Fishman, B., & Marx, R. (2003). *The relationship between professional development and student learning: exploring the link through design research* (Paper presented at the annual meeting of the American Educational Research Association). Chicago, IL.

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

Lawson, H., Duran, F., Wilcom, K., Gregory, K., Schiller, K., & Zuckerman, S. (2017). The role of district and school leaders' trust and communications in the simultaneous implementation of innovative policies. *Journal of School Leadership*.

Lei, J., & Zhao, Y. (2008). One-to-one computing: What does it bring to schools? *Journal of Educational Computing Research*, *39*(2), 97–122.

Leithwood, K. (1994). Leadership for school restructuring. *Educational Administration Quarterly*, *30*(4), 498–518. JOUR.

Leithwood, K., Harris, A., & Hopkins, D. (2008). Seven strong claims about successful school leadership. *School Leadership & Management*, *28*(1), 27–42.

Leithwood, K., Louis, K. S., Anderson, S., Wahlstrom, K., Minnesota Univ., M. C. for A. R. and E. I., & Ontario Inst. for Studies in Education, T. (2004). *How leadership influences student learning. Review of research*. *Wallace Foundation, The*. Wallace Foundation, The.

LeMagie, S. (2010, November 21). 1 student, 1 laptop proves costly. *Star Tribune*, p. 1. St. Paul, MN.

Levin, T., & Wadmany, R. (2008). Teachers' views on factors affecting effective integration of information technology in the classroom: Developmental scenery. *Journal of Technology and Teacher Education*. Norfolk: Association for the Advancement of Computing in Education.

Lewis-Beck, M., Bryman, A., & Liao, T. (2004). *The Sage encyclopedia of social science research methods; 3v*. *Reference and Research Book News* (Vol. 19). Portland: Ringgold Inc.

Ling, K., Beenen, G., & Ludford, P. (2005). Using social psychology to motivate contributions to online communities. *Journal of Computer-Mediated Communication*. Oxford, UK: Blackwell Publishing Ltd. https://doi.org/10.1111/j.1083-6101.2005.tb00273.x

Lloyd, M., & Mcrobbie, C. (2005). The "whole approach": An investigation of a school-based practicum model of teacher professional development in ICT. *Journal of Educational Computing Research*, *32*(4), 341–351.

Loving, C. C., Schroeder, C., Kang, R., Shimek, C., & Herbert, B. (2007). Blogs: Enhancing links in a professional learning community of science and mathematics teachers. *Contemporary Issues in Technology and Teacher Education (CITE Journal)*, *7*(3), 178–198.

Lowther, D. L., Inan, F. A., Strahl, J. D., & Ross, S. M. (2008). Does technology integration "work" when key barriers are removed? *Educational Media International*, *45*(3), 195–213.

Lu, R., & Overbaugh, R. C. (2009). School environment and technology implementation in K-12 classrooms. *Computers in the Schools*, *26*(2), 89–106.

Lumpe, A. T., & Chambers, E. (2001). Assessing teachers' context beliefs about technology use. *Journal of Research on Technology in Education*, *34*(1), 93–107.

Machado, L. J., & Chung, C.-J. (2015). Integrating technology: The principals' role and effect. *International Education Studies*, *8*(5), 43–53.

Marks, H. M., & Printy, S. M. (2003). Principal leadership and school performance: An integration of transformational and instructional leadership. *Educational Administration Quarterly*. Sage CA: Thousand Oaks, CA: Sage Publications. https://doi.org/10.1177/0013161X03253412

May, H., & Supovitz, J. A. (2011). The scope of principal efforts to improve instruction. *Educational Administration Quarterly*. Sage CA: Los Angeles, CA: SAGE Publications. https://doi.org/10.1177/0013161X10383411

McCarthy, P., & Breen, Y. L. (2001). *Teaching and learning for tomorrow: A learning plan for Maine's Future*. Augusta, Maine.

McHale, T. (2006). One-to-one in Michigan - The first in a series of articles examining one-to-one programs across the nation. *Technology & Learning*. Dayton: New Bay Media LLC.

McLeod, S. (2015). The challenges of digital leadership. *Independent School*, *74*(2).

Ming, T. S., Murugaiah, P., Wah, L. K., Azman, H., Yean, T. L., & Sim, L. Y. (2010). Grappling with technology: A case of supporting Malaysian "smart school" teachers' professional development. *Australasian Journal of Educational Technology*, *26*(3), 400–416.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054.

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

Molnar, M. (2014). Chromebooks gain in K-12 Market, challenging iPads. Retrieved December 18, 2016, from http://www.edweek.org/ew/articles/2014/11/12/12chromebooks-market.h34.html

Mouza, C. (2006). Linking professional development to teacher learning and practice: A multi-case study analysis of urban teachers. *Journal of Educational Computing Research*, *34*(4), 405–440.

Muijs, D. (2004). Doing quantitative research in education. Thousand Oaks;Ipswich; SAGE Publications, Incorporated.

National Middle School Association. (1993). *This we believe: Developmentally responsive middle schools*. Columbus, Ohio: National Middel Schools Assiciation.

Networking, C. for S. (2004). *Digital leadership divide*. *Consortium for School Networking*. Consortium for School Networking.

New York, S. (2016). The counties of New York State.

New York City Department of Education. (2016). About Us - New York City Department of

Education. Retrieved December 29, 2016, from http://schools.nyc.gov/AboutUs/default.htm

Nolasco, P. (2009). *Principal leadership behaviors which influence technology in middle schools*. UNIVERSITY OF LA VERNE. https://doi.org/Available from Education Database; ProQuest Central. (305067289)

NYSED. (2015a). New York State report card. Retrieved from http://data.nysed.gov/

NYSED. (2015b). Smart schools bond act: Educational management: P-12: NYSED. Retrieved November 13, 2016, from http://www.p12.nysed.gov/mgtserv/smart_schools/

NYSED. (2015c). What is a similar school. Retrieved from http://www.p12.nysed.gov/repcrd2004/information/similar-schools/guide.shtml

NYSED. (2016a). Computer based testing. Retrieved from https://cbtsupport.nysed.gov/hc/en-us

NYSED. (2016b). CTLE Requirements for ELL/MLL Educators | New York State Education Department. Retrieved March 12, 2017, from http://www.nysed.gov/bilingual-ed/teachers/continuing-teacher-and-leader-education-ctle-requirements-ellmll-educators

NYSED. (2016c). Fiscal reporting profile. Retrieved from http://www.oms.nysed.gov/faru/Profiles/profiles_cover.html

O'Dwyer, L. M., Russell, M., & Bebell, D. (2005). Identifying teacher, school, and district characteristics associated with middle and high school teachers' use of technology: A multilevel perspective. *Journal of Educational Computing Research*, *33*(4), 369–393.

O'Hanlon, C. (2007). 1-to-1 computing: A measure of success. *T.H.E. Journal*, *34*(2), 26–32.

O'Hara, S., Pritchard, R., Huang, C., & Pella, S. (2013). Learning to integrate new technologies into teaching and learning through a design-based model of professional development.

Journal of Technology and Teacher Education, *21*(2), 203–223.

Oliver, K. M., & Corn, J. O. (2008). Student-reported differences in technology use and skills after the implementation of one-to-one computing. *Educational Media International*, *45*(3), 215–229.

Overbaugh, R., & Lu, R. (2009). The impact of a federally funded grant on a professional development program: Teachers' stages of concern toward technology integration. *Journal of Computing in Teacher Education*, *25*(2), 45–55.

Palak, D., & Walls, R. T. (2009). Teachers' beliefs and technology practices: A mixed-methods approach. *Journal of Research on Technology in Education*, *41*(4), 417–441.

Parr, J. M. (1999). Extending educational computing: A case of extensive teacher development and support. *Journal of Research on Computing in Education*. Washington: Taylor & Francis Ltd.

Partnership for 21st Century Skills. (2010). *21ST Century knowledge and skills in educator preparation*.

Pennsylvania Department of Education. (2006). *Classrooms for the future millennial students*. Harrisburg.

Penuel, W. R. (2006). Implementation and effects of one-to-one computing initiatives: A research synthesis. *Journal of Research on Technology in Education*, *38*(3), 329–348.

Phi Coefficient (Mean Square Contingency Coefficient). (2016). Retrieved February 9, 2017, from http://www.statisticshowto.com/phi-coefficient-mean-square-contingency-coefficient/

Pierce, R., & Ball, L. (2009). Perceptions that may affect teachers' intention to use technology in

secondary mathematics classes. *Educational Studies in Mathematics*, *71*(3), 299–317.

Pierson, M. E. (2001). Technology integration practice as a function of pedagogical expertise. *Journal of Research on Technology in Education*, *33*(4).

Plair, S. K. (2008). Revamping professional development for technology integration and fluency. *Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *82*(2-), 70–74.

Ponder, G., Maher, M., & Adams, M. B. T.-E. of C. S. (2010). Teacher education curriculum, professional development, history of. In C. I. B.-978-1-4129-5883-7 I. B.-978-1-4129-5880-6 Kridel (Ed.), *Encyclopedia of Curriculum Studies* (Vol. 2, pp. 858–861). Thousand Oaks, CA: SAGE Reference.

Price, H. E. (2012). Principal-teacher interactions: How affective relationships shape principal and teacher attitudes. *Educational Administration Quarterly*, *48*(1), 39–85.

Pritchett, C. G., Pritchett, C. C., & Wohleb, E. C. (2013). Usage, barriers, and training of web 2.0 technology applications. *SRATE Journal*, *22*(2), 29–38.

ProjectTomorrow. (2010). *Project tomorrow | speak up*.

Reeves, D. B. (2004). Evaluating administrators. *Educational Leadership*. Alexandria: Association for Supervision and Curriculum Development.

Riverin, S., & Stacey, E. (2008). Sustaining an online community of practice: A case study. *Journal of Distance Education*, *22*(2), 43–58.

Rodriguez, G., & Knuth, R. (2000). *Critical issues*. Naperville, IL.

Rogers, B. (2000a). *The correlation between teachers' perceptions of principals' technology leadership and the integration of educational technology*. Unpublished Doctoral

Dissertation.

Rogers, B. (2000b). *The correlation between teachers' perceptions of principals' technology leadership and the integration of educational technology*. Ball State University, IN.

Ross, C. R., Maninger, R. M., LaPrairie, K. N., & Sullivan, S. (2015). The use of Twitter in the creation of educational professional learning opportunities. *Administrative Issues Journal: Education, Practice, and Research*, *5*(1), 55–76.

Russell, M., Bebell, D., & Higgins, J. (2004). Laptop learning: A comparison of teaching and learning in upper elementary classrooms equipped with shared carts of laptops and permanent 1:1 laptops. *Journal of Educational Computing Research*, *30*(4), 313–330.

Schlager, M. S., & Fusco, J. (2003). Teacher professional development, technology, and communities of practice: Are we putting the cart before the horse? *Information Society*, *19*(3), 203.

Schrum, L., & Levin, B. B. (2013). Lessons learned from exemplary schools. *TechTrends: Linking Research and Practice to Improve Learning*, *57*(1), 38–42.

Schwartz, K. (2017). Can micro-credentials create more meaningful professional development for teachers? Retrieved March 12, 2017, from https://ww2.kqed.org/mindshift/2017/02/15/can-micro-credentials-create-meaningful-professional-development-for-teachers/?goal=0_f641d2e0f6-beaa35274f-202605221&mc_cid=beaa35274f&mc_eid=33b7b357a5

Scott, P., & Mouza, C. (2007). The impact of professional development on teacher learning, practice and leadership skills: A study on the integration of technology in the teaching of

writing. *Journal of Educational Computing Research*, *37*(3), 229–266.

Shapley, K., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2011). Effects of technology immersion on middle school students' learning opportunities and achievement. *Journal of Educational Research*, *104*(5), 299–315.

Sheninger, E. (2014). *Digital leadership: Changing paradigms for changing times*. Thousand Oaks, Ca: Corwin.

Sheumaker, F., Slate, J. R., & Onwuegbuzie, A. J. (2001). The role of intech training in the integration of technology into instructional practices among Georgia middle school teachers. *Journal of Research on Technology in Education*, *33*(5).

Shuldman, M. (2004). Superintendent conceptions of institutional conditions that impact teacher technology integration. *Journal of Research on Technology in Education*, *36*(4), 319–343.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4–14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, *57*(1), 1–22.

Skues, J. L., & Cunningham, E. G. (2013). The role of e-learning coaches in Australian secondary schools. *Journal of Computer Assisted Learning*, *29*(2), 179–187.

Smolin, L., & Lawless, K. A. (2011). Evaluation across contexts: Evaluating the impact of technology integration professional development partnerships. *Journal of Digital Learning in Teacher Education*, *27*(3), 92–98.

Spires, H. A., Oliver, K., & Corn, J. (2012). The new learning ecology of one-to-one computing

environments: Preparing teachers for shifting dynamics and relationships. *Journal of Digital Learning in Teacher Education*, *28*(2), 63–72.

Stevenson, H. J. (2005). Teachers' informal collaboration regarding technology. *Journal of Research on Technology in Education*, *37*(2), 129–144.

Strudler, N., Donovan, L., & Hartley, K. (2011). Teacher concerns during initial implementation of a one-to-one laptop initiative at the middle school level. *Considerations on Educational Technology Integration : The Best of JRTE*.

Sugar, W., & van Tryon, P. J. S. (2014). Development of a virtual technology coach to support technology integration for K-12 educators. *TechTrends: Linking Research and Practice to Improve Learning*, *58*(3), 54–62.

Sugar, W., & Wilson, K. (2005). Seeking alternatives to inservice technology workshops from teachers' perspectives. *Journal of Computing in Teacher Education*, *21*(4), 91–98.

Survey Monkey. (2016). Palo Alto, Ca.

Survey Monkey-Privacy Policy. (2016). Palo Alto, Ca.

Swan, K., Kratcoski, A., Mazzer, P., & Schenker, J. (2005). Bringing Mohamed to the mountain: Situated professional development in a ubiquitous computing classroom. *Journal of Educational Computing Research*, *32*(4), 353–365.

Texas Center for Education Research. (2004). *Final outcomes for a four-year study*. Austin, TX.

The Pennsylvania State University. (2017). 18.3 - Kendall Tau-b Correlation Coefficient | STAT 509. Retrieved February 25, 2017, from https://onlinecourses.science.psu.edu/stat509/node/158

Trust, T. (2012). Professional learning networks designed for teacher learning. *Journal of Digital Learning in Teacher Education*, *28*(4), 133–138.

Tsai, C.-C., & Chai, C. S. (2012). The "Third"-Order Barrier for Technology-Integration Instruction: Implications for Teacher Education. *Australasian Journal of Educational Technology*, *28*(6), 1057–1060.

Tschannen-Moran, M. (2014). Trust matters: Leadership for successful schools. San Francisco: Jossey-Bass.

Tschannen-Moran, M., & Gareis, C. (2015). Faculty trust in the principal: An essential ingredient in high-performing schools. *Journal of Educational Administration*, *53*(1), 66–92.

Twining, P., Raffaghelli, J., Albion, P., & Knezek, D. (2013). Moving education into the digital age: The contribution of teachers' professional development. *Journal of Computer Assisted Learning*, *29*(5), 426–437.

U.S. Department of Education. (2016). *Future ready learning: Reimagining the role of technology in education*. Washington, D.C.

Vascellaro, J. (2006, August 31). Saying no to school laptops. *The Wall Street Journal*, p. 1. New York.

Vavasseur, C. B., & MacGregor, S. K. (2008). Extending content-focused professional development through online communities of practice. *Journal of Research on Technology in Education*, *40*(4), 517–536.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of

information technology: Toward a unified view. *MIS Quarterly*. The Society for Information Management and The Management Information Systems Research Center of the University of Minnesota, and The Association for Information Systems.

Villano, M. (2008). Five on five: A dialogue on professional development. *T.H.E. Journal*, *35*(3), 40–42.

Vogt, W. P., Gardner, D. C., & Haeffele, L. . (2012). *When to use what research design*. New York, NY: The Guilford Press.

Walker, A., Recker, M., Ye, L., Robertshaw, M. B., Sellers, L., & Leary, H. (2012). Comparing technology-related teacher professional development designs: A multilevel study of teacher and student impacts. *Educational Technology Research and Development*, *60*(3), 421–444.

Wasko, M., & Faraj, S. (2000). "It is what one does": Why people participate and help others in electronic communities of practice. *Journal of Strategic Information Systems*. Elsevier B.V. https://doi.org/10.1016/S0963-8687(00)00045-7

Wenger, E. (1998). *Communities of practice: learning, meaning, and identity*. Cambridge, Ma: Cambridge University Press.

Weston, M. E., & Bain, A. (2010). The end of techno-critique: The naked truth about 1:1 laptop initiatives and educational change. *Journal of Technology, Learning, and Assessment*, *9*(6).

Whale, D. (2006). Technology skills as a criterion in teacher evaluation. *Journal of Technology and Teacher Education*, *14*(1), 61–74.

Williams, L. A., Atkinson, L. C., Cate, J. M., & O'Hair, M. J. (2008). Mutual support between learning community development and technology integration: Impact on school practices

and student achievement. *Theory Into Practice*, *47*(4), 294–302.

Windschitl, M., & Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. *American Educational Research Journal*, *39*(1), 165–205.

Youngs, P., & King, M. B. (2002). Principal leadership for professional development to build school capacity. *Educational Administration Quarterly*, *38*(5), 643–670.

Yuen, A. H. K., & Ma, W. W. K. (2008). Exploring teacher acceptance of e-learning technology. *Asia-Pacific Journal of Teacher Education*, *36*(3), 229–243.

Zhao, Y., & Frank, K. A. (2003). Factors affecting technology uses in schools: An ecological perspective. *American Educational Research Journal*. Sage CA: Thousand Oaks, CA: American Educational Research Association. https://doi.org/10.3102/00028312040004807

Zheng, B., Warschauer, M., Lin, C.-H., & Chang, C. (2016). Learning in One-to-One Laptop Environments: A Meta-Analysis and Research Synthesis. *Review of Educational Research*. Washington: American Educational Research Association. https://doi.org/10.3102/0034654316628645

Zucker, A. A., & Light, D. (2009). Laptop programs for students. *Science*, *323*(5910), 82–85. https://doi.org/10.1126/science.1167705

Appendix A: IRB Approval

School of Health Sciences

Deans Office
65 1st Street
Troy, New York 12180
518.244.2264
Fax: 518.244.4571
sage.edu/academics/health-sciences

October 25, 2016

Dr. Francesca Durand
The Sage Colleges
Educational Leadership Dept.
140 New Scotland Avenue
Albany, NY 12208

IRB PROPOSAL #536-2016-2017
Reviewer: Francesca Durand, Chair

Dear Dr. Durand:

The Institutional Review Board has reviewed your application and has approved your project entitled "The Effect of Types of Professional Development and Middle School Principals' Leadership Actions on Instructional Technology Integration in the Middle School One-to-One Classroom." Good luck with your research.

Please refer to your IRB Proposal number whenever corresponding with us whether by mail or in person.

When you have completed collecting your data you will need to submit to the IRB Committee a final report indicating any problems you may have encountered regarding the treatment of human subjects, if the project goes on for more than one year.

Please let me know if you have any questions.

Sincerely,

Francesca Durand, PhD
Chair, IRB

FD/nan

Appendix B: Letter to Superintendents

November 1, 2016

Dear Superintendent :

I am writing to let you know about an opportunity for your staff to participate in a research study about the forms of professional development that create the greatest integration of technology in the one-to-one classroom. This study is being conducted by David Casamento, Doctoral Candidate in Educational Leadership at The Sage Colleges.

This study will investigate if the form of instructional technology professional development a teacher participates in relates to the likelihood of a teacher integrating technology in their one-to-one classroom. The study will also investigate principal actions that influence teachers to participate in instructional technology professional development as well as the relationship between those actions and the likelihood of teacher integration of instructional technology in the one-to-one classroom. Finally, the study seeks to identify teacher biases and institutional barriers to integrating instructional technology in the one-to-one classroom.

You are receiving this letter because a few months ago I asked Long Island Technology Directors and Middle School Principals if they had at least one grade with a one-to-one device in their middle schools. From this questionnaire, your district was identified as having at least one grade in the middle school with a one-to-one environment. The device does not matter.

I would greatly appreciate your permission to conduct this survey with the middle school teachers in your district. This would necessitate each of your middle school principals or their designee distributing the enclosed survey to their staff via email. Teacher participants will take a 20 minute online survey and participation is entirely voluntary and may stop taking the survey at any time or refuse to take the survey in its entirety. The survey is completely anonymous and all responses will be aggregated from all locations taking the survey. There are no identifiers by school or district.

Your assistance in conducting this education study is greatly appreciated. If you have any questions about this research project, please contact me at (631) 838-5309 or at casamd@sage.edu. You may also contact the dissertation chairperson, Dr. Francesca Duran at durnaf@sage.edu for further information regarding this study.

Sincerely,

David Casamento
Enclosure

Appendix C: Letter to Principals

November 17, 2016

Dear Principal :

I am writing to let you know about an opportunity for your staff to participate in a research study about the forms of professional development that create the greatest integration of technology in the one-to-one classroom. This study is being conducted by David Casamento, Doctoral Candidate in Educational Leadership at The Sage Colleges. This study will investigate if the form of instructional technology professional development a teacher participates in relates to the likelihood of a teacher integrating technology in their one-to-one classroom. The study will also investigate principal actions that influence teachers to participate in instructional technology professional development as well as the relationship between those actions and the likelihood of teacher integration of instructional technology in the one-to-one classroom. Finally, the study seeks to identify teacher biases and institutional barriers to integrating instructional technology in the one-to-one classroom.

You are receiving this letter because a few months ago I asked Long Island Technology Directors and Middle School Principals if they had at least one grade with a one-to-one device in their middle schools. From this questionnaire, your school was identified as having at least one grade with a one-to-one environment. I am seeking approximately 1500 teachers across Long Island to participate in this survey if they work in a one-to-one classroom. The device does not matter.

I am writing to ask your permission to utilize your school and your teachers for this study. Teacher participants will take a 20 minute online survey and participation is entirely voluntary. Participants may stop taking the survey at any time or refuse to take the survey in its entirety.

If you agree to allow your school and teachers participate, I will send you the link to the survey during the first week of January for distribution to your teachers. The survey is completely anonymous and all responses will be aggregated from all locations taking the survey. There are no identifiers by school or district.

Kindly email me at casamd@sage.edu if you are willing to allow the use your school and teachers for this study. Thank you again for your time, and I look forward to your response.

Further questions can be directed to David Casamento at casamd@sage.edu or the dissertation chairperson, Francesca Duran at durnaf@sage.edu.

David Casamento

Appendix D: Survey

Professional Development and Technology Integration Survey

Welcome to My Survey

You are being asked to take this survey as part of the doctoral dissertation by David Casamento, Doctoral Candidate in Educational Leadership at The Sage Colleges. The purpose of this project is to understand the relationship between types of instructional technology professional development teachers participate in and the likelihood of instructional technology integration in the one-to-one middle school classroom. For this reason, all full time middle school classroom teachers of one-to-one classrooms are invited to complete this survey. To obtain a complete, accurate picture of your school, we need thoughtful, candid responses from every participant.

***Participation in this survey is voluntary but greatly appreciated.**

*** As you respond to each item, please focus on your thoughts and feelings based on your own personal experiences as a staff member at your school and in your classroom.**

*** There are no right or wrong answers. Your responses will provide us with important information about effective professional development, effective principal leadership, and effective instructional technology integration.**

*** All your responses are completely anonymous. No one from your school or district will ever see your answers. No identifying information (name, ID, classroom, or survey ID) will be connected to your answers. Results will be reported in aggregate form and for only groups of at least five individuals.**

This survey is expected to take no more than 20 minutes to complete.

Further questions can be directed to David Casamento at casamd@sage.edu or the dissertation chairperson, Francesca Duran at durnaf@sage.edu.

1. I have read the above statement and understand that I am volunteering to participate in this anonymous survey and may opt-out at any time. By clicking yes below, you are agreeing to your participation in this study.

- ◯ Yes
- ◯ No

1

Professional Development and Technology Integration Survey

Demographics

Please answer the following questions to the best of your ability.

2. What is your gender?

- ◯ Female
- ◯ Male

3. Including this year, how many years have you been teaching?

- ◯ 1-5 Years
- ◯ 6-10 Years
- ◯ 11-15 Years
- ◯ 16-20 Years
- ◯ 21-25 Years
- ◯ 26-30 Years
- ◯ 31+ Years

4. Please estimate the percent of students receiving free and reduced lunch in your building.

- ◯ Less than 20%
- ◯ 20% - 69%
- ◯ Greater than 70%

5. What is the total student enrollment in the middle school in which you work?

- ◯ Less than 100
- ◯ 101-250
- ◯ 251-500
- ◯ 501-750
- ◯ 751-1000
- ◯ 1001+

6. In which area do you teach the majority of your day

- ◯ English Language Arts including AIS or in a literacy support capacity
- ◯ Social Studies
- ◯ Mathematics including AIS or in a mathematics support capacity
- ◯ Science
- ◯ Languages Other Than English
- ◯ English to Speakers of Other Languages
- ◯ Visual Arts
- ◯ Music
- ◯ Instructional Technology (Computer Classes)
- ◯ Technology Education
- ◯ Family and Consumer Science
- ◯ Special Education
- ◯ Library Media Specialist
- ◯ Health
- ◯ Other (please specify)

Professional Development and Technology Integration Survey

Professional Development

In this section you will be asked a series of questions about the three types of instructional technology professional development and their impact on your ability to integrate technology in the one-to-one classroom. Please use the definitions below as your guide:
Formal professional development are those activities that are arranged by the district, are aligned to district goals, and are held at a predetermined time and place. Examples of such activities include workshops, conferences, in-service courses, online courses that are district sponsored or suggested, college courses, professional learning communities (PLCs) established by your school/district, or met with the district employed technology integration coach (Garet et al., 2001; Jones & Dexter, 2014).

Informal professional development includes participation in collegial circles or community of practice (COP), collaboration with a colleague during lunch, on preps, or between classes about instructional technology or instructional technology integration , collaboration with a perceived technology savvy teacher or administrator with the same or greater comfort with technology, consultation with students, participation in an internship, and mentoring or being mentored by a fellow teacher or administrator (Jones & Dexter, 2014). In general, these activities take place during the school day and are not organized by the school or district.

Independent professional development are those activities that the teacher seeks and participates in on their own time usually outside of the school day. These activities include using Facebook, Pinterest, Twitter, a Twitter Chat, Google Search, Wiki, Blog, online webinar or course not district endorsed or suggested, or developed or maintained a professional learning network (PLN) (Jones & Dexter, 2014).

7. Formal professional development are those activities that are arranged by the district, are aligned to district goals, and are held at a predetermined time and place. How many times have you participated in formal instructional technology professional development during the past twelve months (ex: workshop, conference, in-service course, online course that is district sponsored or suggested, college course, professional learning communities (PLC) established by your school/district, or met with the district employed technology integration coach) . Activities that occurred multiple times over the course of the year should be counted once (ex. a course that had 4 parts should be counted as 1 occurrence)

- ◯ 0
- ◯ 1-3
- ◯ 4-6
- ◯ 7-9
- ◯ 10+

8. After participating in formal instructional technology professional development opportunities, I incorporated what I learned in the classroom by having students:

	Yes	No	N/A
Perform experiments and analyze information	◯	◯	◯
Complete online tasks that utilize critical thinking	◯	◯	◯
Work collaboratively with their peers	◯	◯	◯
Use social media for projects	◯	◯	◯
Work with peers to problem solve	◯	◯	◯
Create and deliver digital presentations	◯	◯	◯

Other (please specify)

9. After participating in formal professional development opportunities, I incorporated what I learned in the classroom to:

	Yes	No	N/A
Facilitate student collaboration beyond the classroom walls	◯	◯	◯
Differentiated learning tasks for individual students (struggling and/or advanced)	◯	◯	◯
Changed the way I deliver content and assess students	◯	◯	◯
Communicate with students, parents, and peers	◯	◯	◯
Incorporate project-based learning	◯	◯	◯
Allow students options for demonstrating understanding of a topic	◯	◯	◯

Other (please specify)

10. Informal professional development activities take place during the school day and are not organized by the school or district. How many times have you participated in informal instructional technology professional development during the past twelve months (ex: collegial circle or community of practice, collaborated with a colleague during lunch, on preps, or between classes about instructional technology or instructional technology integration, collaborated with a perceived technology savvy teacher or administrator with the same or greater comfort with technology, consulted with students, participated in an internship, and mentoring or being mentored by a fellow teacher or administrator)?

- ◯ 0
- ◯ 1-3
- ◯ 4-6
- ◯ 7-9
- ◯ 10+

11. After participating in informal instructional technology professional development opportunities, I incorporated what I learned in the classroom to have students:

	Yes	No	N/A
Perform experiments and analyze information	◯	◯	◯
Complete online tasks that utilize critical thinking	◯	◯	◯
Work collaboratively with their peers	◯	◯	◯
Use social media for projects	◯	◯	◯
Work with peers to problem solve	◯	◯	◯
Create and deliver digital presentations	◯	◯	◯

Other (please specify)

12. After participating in informal instructional technology professional development opportunities, I incorporated what I learned in the classroom to:

	Yes	No	N/A
Facilitate student collaboration beyond the classroom walls	◯	◯	◯
Differentiated learning tasks for individual students (struggling and/or advanced)	◯	◯	◯
Changed the way I deliver content and assess students	◯	◯	◯
Communicate with students, parents, and peers	◯	◯	◯
Incorporate project-based learning	◯	◯	◯
Allow students options for demonstrating understanding of a topic	◯	◯	◯

Other (please specify)

13. Independent professional development are those activities that the teacher seeks and participates in on their own time usually outside of the school day. How many times have you participated in independent instructional technology professional development during the past twelve months (ex: Facebook, Pinterest, Twitter, a Twitter Chat, Google Search, Wiki, Blog, online webinar or course not district endorsed or suggested, or developed or maintained a professional learning network (PLN))

- ◯ 0
- ◯ 1-3
- ◯ 4-6
- ◯ 7-9
- ◯ 10+

14. After participating in independent instructional technology professional development opportunities, I incorporated what I learned in the classroom to have students:

	Yes	No	N/A
Perform experiments and analyze information	◯	◯	◯
Complete online tasks that utilize critical thinking	◯	◯	◯
Work collaboratively with their peers	◯	◯	◯
Use social media for projects	◯	◯	◯
Work with peers to problem solve	◯	◯	◯
Create and deliver digital presentations	◯	◯	◯

Other (please specify)

15. After participating in independent instructional technology professional development opportunities, I incorporated what I learned in the classroom to:

	Yes	No	N/A
Facilitate student collaboration beyond the classroom walls	◯	◯	◯
Differentiated learning tasks for individual students (struggling and/or advanced)	◯	◯	◯
Changed the way I deliver content and assess students	◯	◯	◯
Communicate with students, parents, and peers	◯	◯	◯
Incorporate project-based learning	◯	◯	◯
Allow students options for demonstrating understanding of a topic	◯	◯	◯

Other (please specify)

Professional Development and Technology Integration Survey

Leadership

Please answer the following questions about the actions your school's principal takes to promote instructional technology professional development and/or the integration of instructional technology in your one-to-one classroom.

16. Of the instructional technology professional development you attended over the previous 12 months, did your principal take any of the following actions to encourage you to integrate this instructional technology in your one-to-one classroom

	Yes	No	N/A
Communicates the goals of the one-to-one technology initiative in my school	◯	◯	◯
Used evaluations to reinforce the importance of one-to-one technology integration in my lessons	◯	◯	◯
Provided release time to collaborate and plan with other teachers to integrate one-to-one technology in the classroom	◯	◯	◯
Asked if I needed further one-to-one technology professional development	◯	◯	◯
Actively sought the resources I needed to integrate one-to-one technology successfully	◯	◯	◯
Worked collaboratively with me to integrate one-to-one technology in my lessons	◯	◯	◯
Modeled one-to-one technology use	◯	◯	◯
Encouraged me to model how I am integrating one-to-one technology to my peers	◯	◯	◯
Encouraged and provided positive reinforcement for me to integrate one-to-one technology	◯	◯	◯
Established trust and encouraged me to take risks integrating one-to-one technology	◯	◯	◯
Highlights successful one-to-one technology integration by staff members to other staff and/or the community	◯	◯	◯
None of the above	◯	◯	◯

Other (please specify)

17. Of the instructional technology professional development you attended over the previous 12 months, did your principal take any of the following actions to encourage you to attend this instructional technology professional development

	Yes	No	N/A
Asked if I needed further one-to-one technology professional development	◯	◯	◯
Encouraged me to model what I learned to my peers	◯	◯	◯
Attended the instructional technology professional development with me	◯	◯	◯
Asked me to participate in a specific instructional technology professional development activity	◯	◯	◯
Established trust and encouraged me to take risks in learning something with which I wasn't previously comfortable	◯	◯	◯
Highlights the one-to-one technology professional development taken by staff members to other staff and/or the community	◯	◯	◯
Provided suggestions for a professional learning community or collegial circle	◯	◯	◯
Provided release time during the school day for collaborative learning	◯	◯	◯
Modeled or instructed the staff on independent professional learning	◯	◯	◯
Asked me to join their PLN	◯	◯	◯
Asks me for suggestions for professional development	◯	◯	◯
None of the above	◯	◯	◯

Other (please specify)

10

Professional Development and Technology Integration Survey

Beliefs and Barriers to Technology Integration

Please answer the following questions to the best of your ability based on any barriers you may experience with instructional technology integration and your beliefs about instructional technology integration in the one-to-one classroom

18. Do you perceive any of the following to be obstacles to integrating technology in your classroom (check all that apply)

- [ ] Lack of time to plan
- [ ] Lack of time to collaborate with peers
- [ ] Lack of time to learn and experiment
- [ ] Lack of time because of outside factors (State testing, changing curriculum, etc.)
- [ ] Lack of hardware/software
- [ ] Lack of professional development
- [ ] None of the above
- [ ] Other (please specify)

19. Please respond with your level of agreement about the following statements:

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
I believe I have the ability to learn new instructional technologies and integrate them in my classroom	○	○	○	○	○
I believe there is an appropriate amount of support in my school to learn and integrate technology in my classroom	○	○	○	○	○
I believe time to plan is important for instructional technology integration	○	○	○	○	○
I believe time to collaborate is important for instructional technology integration	○	○	○	○	○
I believe time to learn new instructional technologies is important for technology integration	○	○	○	○	○
I believe if I attend PD, the school will provide me with the resources I need to implement what I have learned	○	○	○	○	○

20. Please respond with your level of agreement about the following statements:

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
I believe that instructional technology in a one-to-one environment has the ability to positively increase student achievement and impact learning	◯	◯	◯	◯	◯
I believe that all students should have a device at all times of the day for instruction	◯	◯	◯	◯	◯
I believe if all students have a device in my class that I will need to change my pedagogical practices to deliver content	◯	◯	◯	◯	◯
I believe if all students have a device, that they will learn the content differently than the way students learn without the devices	◯	◯	◯	◯	◯
I understand the instructional technology one-to-one vision of my school	◯	◯	◯	◯	◯
I support the instructional technology one-to-one vision of my school	◯	◯	◯	◯	◯