Spring 2017

Professional Learning Community (PLC): Technology Integration at a Title I Elementary School

Pamela Lan Cheng
San Jose State University

Follow this and additional works at: https://scholarworks.sjsu.edu/etd_dissertations

Recommended Citation

Cheng, Pamela Lan, "Professional Learning Community (PLC): Technology Integration at a Title I Elementary School" (2017). *Dissertations*. 4.
DOI: <https://doi.org/10.31979/etd.58wj-dk5q>
https://scholarworks.sjsu.edu/etd_dissertations/4

This Dissertation is brought to you for free and open access by the Master's Theses and Graduate Research at SJSU ScholarWorks. It has been accepted for inclusion in Dissertations by an authorized administrator of SJSU ScholarWorks. For more information, please contact scholarworks@sjsu.edu.

PROFESSIONAL LEARNING COMMUNITY (PLC):
TECHNOLOGY INTEGRATION AT A TITLE I ELEMENTARY SCHOOL

A Dissertation

Presented to

The Faculty of the Educational Doctoral Program in Educational Leadership

San José State University

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

by

Pamela L. Cheng

May 2017

© 2017

Pamela L. Cheng

ALL RIGHTS RESERVED

The Designated Dissertation Committee Approves the Dissertation Titled

PROFESSIONAL LEARNING COMMUNITY (PLC):
TECHNOLOGY INTEGRATION AT A TITLE I ELEMENTARY SCHOOL

by

Pamela L. Cheng

APPROVED FOR THE EDUCATIONAL DOCTORAL PROGRAM IN
EDUCATIONAL LEADERSHIP

SAN JOSÉ STATE UNIVERSITY

May 2017

Arnold Danzig, Ph.D.	Director, EdD Leadership Program
Marcos Pizarro, Ph.D.	Department of Mexican American Studies
Jonathan Lovell, Ph.D.	English Department
Michael Gallagher, Ed.D.	Deputy Superintendent of Schools, Sunnyvale School District

ABSTRACT

PROFESSIONAL LEARNING COMMUNITY (PLC): TECHNOLOGY INTEGRATION AT A TITLE I ELEMENTARY SCHOOL

by Pamela L. Cheng

Calls for educational technology integration over more than thirty years have taken on new urgency in an era of computerized assessments for accountability. As Internet Communication Technology (ICT) becomes more widely available, the digital divide is evolving into a digital use divide, characterized by differences between students' productive uses of technology to create and communicate compared with passive uses for entertainment or skills practice. A growing body of research points to the important interplay among teachers' frames of reference, school-level context, and alignment of supports in creating conditions for technology innovation. Meanwhile Professional Learning Communities (PLCs) hold potential as leverage points for affecting teacher beliefs and practices regarding technology use. This study analyzes interactions among a group of teacher leaders participating in a tech PLC at a school on the verge of becoming a technology-focused school. Analysis of the group's natural discourse points to important elements of teacher talk and shared resources that contribute to aligning the group's goals and practices when innovating with technology. It also illustrates how alignment between meso-level and micro-level context factors help to facilitate teachers' ability to innovate in ways that have the potential to address the digital use divide.

DEDICATION

This dissertation has been at once an idealistic and selfish pursuit, which has born more fruit than I could have anticipated. It would have been unreachable without the guidance and confidence of many whom I respect and admire, and it would have been impossible without the support and sacrifice of loved ones.

To my cohort mates, the First Sixteen—my friends in adventure and untold struggles—your perspectives, willingness to ask hard questions and insistence on looking for others' strengths will live on in my heart. In the face of it all, Pura Vida!

To the teachers who participated in this study, I am humbled by your energy, intellect, and love for our students. Thank you for holding me to my own values, calling me on my mistakes, and believing in what we could accomplish together. To my critical friend, you made this work fun by being a worthy thought partner and by sharing the richness of your many perspectives and endless interests.

My gratitude goes out to an amazing network of mentors whom I have been blessed to get to know and work with through this process and leading up to it. Vicki Park, thank you for sparking the idea in your qualitative methodology class and for teaching us that there is no such thing as an unbiased study. Your help thinking through this one helped to make it possible. Marcos Pizarro, you challenge as you support, consistently setting high standards then helping your students to achieve what once seemed impossible. Thank you for your unassuming steadfastness, and for always making time and room because of your decency and kindness. To Michael Gallagher, who has been a professional mentor and role model—you've never failed to simplify and support. Thank you for playing

Jiminy Cricket in my moments of uncertainty. To Jonathan Lovell, a teacher among teachers, thank you for hearing my voice before I could make it out for myself. Your support and faith as you've watched me "grow up" professionally has been at once foundational and full of heart. And to Arnold Danzig, thank you for elevating the study and examination of the humanistic side of school leadership. By nudging me to look for and tell the stories around me, you have helped me to better tell my own. This was the best guidance that an earnest administrator and hopeful scholar could have wished for.

Finally and most importantly, this undertaking would have been impossible without the support of my family. To Chang, Emma, and Sophie: for the nights when I closed the door and missed your kisses goodnight, for the trips you didn't take just to stay close, for the complaints you swallowed instead of rightfully alleged—thank you is not enough. Yet my gratitude for these three years will have to serve as a start. Thank you for your pride in my accomplishments. Thank you for your forgiveness in my failures. Thank you for your love and support—even through the long stretches when all I could manage was to pass through our home as "the hotel guest." I love you with all my heart.

TABLE OF CONTENTS

List of Tables.....	x
List of Figures.....	xi
List of Abbreviations.....	xii
Chapter 1. Introduction.....	1
Overview.....	1
Statement of the Problem.....	4
Purpose of the Study.....	7
Definition of Terms.....	9
Significance of the Study.....	11
Chapter 2. Literature Review.....	12
Overview.....	12
The Evolving Digital Divide—A National Continuum of Access and Usage.....	14
Poverty in American Schools, a Growing Status Quo.....	15
Technology Access: Haves and Have-Nots.....	16
Devices and connectivity in homes.....	17
Devices and connectivity in schools.....	18
New Equity Focus: the Digital Use Divide.....	19
SES and the digital use divide.....	20
Accountability policies may exacerbate differences.....	22
Inequality in America’s schools: a legacy of educational debt exacerbated by deficit views inherent in accountability movement’s focus on achievement gap.....	23
Effects of teachers’ perceptions of students on bridging the divide.....	25
Opportunities for Equitable Technology Integration.....	28
The Call for Technology in Education in the U.S.: Historical Overview.....	30
The Rationale for Technology in Education.....	31
Policies, Politics, Pitch: Changing Drivers of Reform.....	32
Lessons from Implementation: Drilling Down to Practices.....	34
Adoption Strategies—Aligning Resources, Leadership and Support.....	34
Teacher Progression Models Point to Learning in Context.....	37

Communities of Practice Support Critical Interactions.....	39
Conditions Needed for Technology Innovation.....	41
Towards a Systems View—Schools as Learning Organizations.....	45
An integrated model of ICT Innovation in a School Learning System.....	48
Professional Learning Community (PLC) as a Leverage Point in the System.	49
Distributed Leadership: Definitions, Relationships to PLCs.....	51
Early definitions of PLCs Relate to Communities of Practice.....	54
PLCs as a Vehicle for Reform	55
Moving towards a framework for an effective technology PLC.....	58
Collective focus on student learning.....	59
Collaborate and problem-solve to reinvent practices.....	60
Build site capacity for distributing leadership.....	63
Summary.....	65
Chapter 3. Methodology.....	69
Introduction.....	69
Statement of the Problem.....	70
Purpose of the Study.....	73
Research Design and Procedures.....	74
Research Methodology and Theoretical Framework.....	76
Population and Sample.....	78
Strategy for selecting site and participants.....	81
Addressing ethical considerations: access, reciprocity, trust, and rapport.	84
Limitation (Internal Validity Threat).....	85
Researcher Stance.....	85
Ethnographic and philosophic influences in this case study.....	86
Positionality.....	89
Self-selection and self-report.	91
Roles.....	92
Defining the PLC structure.....	94
Delimitations (External Validity Threats).....	95
Stakeholder insights.....	95
Instrumentation to Answer Research Questions.....	96

Research Question #1: How is participation in a technology PLC associated with teacher beliefs and practices related to addressing the digital use divide?.....	96
Research Question #2: What are the aspects of the PLC that facilitate teachers' innovative practices related to addressing the digital use divide?.....	99
Research Question #3: What are the interactions between school-based context factors and teacher collaboration and learning in the PLC?.....	102
Sources of Information.....	103
Data Collection Procedures.....	104
Data Analysis Procedures.....	105
Quantitative Procedures.....	107
Qualitative Procedures.....	108
Chapter 4. Findings.....	110
Introduction.....	110
Brief Narrative Description of the Participants.....	111
Description of Results: from Survey Data to PLC Goals, Artifacts, and Plans....	116
RQ #1: How is Participating in a Tech PLC Associated with Teacher Beliefs and Practices Related to Addressing the Digital Use Divide?.....	121
Beliefs and Practices: Addressing the Digital Use Divide through School-wide Focus on Real Tech Skills for Students.....	126
RQ #2: What are the Aspects of the PLC that Facilitate Teachers' Innovative Practices Related to Addressing the Digital Use Divide?.....	132
Teacher Talk—Building Blocks for a Productive Professional Learning Community.....	137
Shared Resources: Foundations for Productive Teacher Talk.....	144
Shared resource: shared context experiences.....	145
Shared resource: aligned resource.....	147
Shared resource: technology skills.....	148
Shared resource: shared vision.....	150
Shared resource: student-centered pedagogy.....	152
Affirmations and Invitations Associated with Sharing Resources and Teacher Talk.....	153

From Meso-Level to Micro-Level Interactions on the way to Aligning Practices.....	158
RQ #3: What are the interactions between school-based context factors and teacher collaboration and learning in the PLC?.....	160
Chapter 5. Discussion, Applications, and Recommendations.....	163
Introduction.....	163
Summary of Findings.....	163
Implications for Practice.....	167
Important Elements of Effective PLCs.....	167
Iterative Processes Support Systemic Change.....	168
Feedback Structures can Leverage System-wide Efforts.....	170
Technology and Change in a Title 1 School.....	171
Incidental Learning.....	172
Effects of Making Space for Research and Reflection.....	174
Leadership Applications.....	176
Recommendations for Future Research.....	178
Conclusion.....	180
References.....	182

LIST OF TABLES

Table 1.	Instruments and Guiding Concepts Related to Research Question #1.....	98
Table 2.	Instruments and Guiding Concepts Related to Research Question #2.....	100
Table 3.	Instruments and Guiding Concepts Related to Research Question #3.....	103

LIST OF FIGURES

Figure 1.	The pedagogy * technology model for ICT integration in education.....	39
Figure 2.	Conditions for classroom technology.....	42
Figure 3.	The emergence of ICT implementation strategies at school and classroom levels.....	46
Figure 4.	An integrated framework of technology innovation factors in a school	49
Figure 5.	Overview of research design.....	77
Figure 6.	Sample of tech skills progression.....	124
Figure 7.	A model of the interactions between school leadership, the tech PLC and the school context in jointly developing the school's vision.....	133
Figure 8.	An analysis of all PLC meeting transcripts depicts the number of associations between Teacher Talk elements.....	138
Figure 9.	An analysis of Teacher Talk over the course of PLC meetings highlight frequencies of the three elements that contribute to building.....	143
Figure 10.	Shared Resources for Teacher Talk over the course of PLC meetings.....	146
Figure 11.	An analysis of overlapping or adjacent occurrences of crosstalk and all sub-codes related to affirmations and invitations.....	155
Figure 12.	Participants' interaction counts in the first hour of Tech PLC meeting compared with the sixth hour.....	156
Figure 13.	A framework of the relationship between a community of practitioners' shared resources & three types of teacher talk that support effective PLC	159

LIST OF ABBREVIATIONS

ICT—Internet Communications Technology

ISTE—International Society for Technology in Education

PLC—Professional Learning Community

NETP—National Educational Technology Plan, published by the U.S. Department of Education Office of Technology

Chapter One

Introduction

Overview

The reform initiative of integrating technology into teaching and learning has involved broad sectors of government, corporations, and educators (Culp, Honey, & Mandinach, 2005) across the extensive landscape and contexts of America's classrooms (File & Ryan, 2014; Gray, Thomas, & Lewis, 2010). As new technologies redefine so many aspects of life and create new career paths, they disrupt traditional ways of living and *learning*. This era of change has challenged schools to re-examine their purposes and practices in order to stay relevant in preparing students for their futures (Dolan, 2016; Harper & Milman, 2016). As the Canadian-American science fiction writer William Gibson says, "The future is already here. It's just not evenly distributed."

This adage remains true though policy makers have been trying to distribute technology into classrooms for more than thirty years (Cuban, 2009). Since *A Nation at Risk* (National Commission on Excellence in Education, 1983) first proposed adding computing as one of the new basic skills alongside traditional content areas, the technology and the vision have both evolved, as have the challenges of reaching that vision (Raddaoui, 2012; Hasselbring & Tulbert, 1991). The most daunting challenge of technology integration into classrooms involves bridging the digital divide (U.S. Department of Education, 2016). A fault line in access and expectations has historically run along differences in income, ethnicity, neighborhood and schools (Anyon, 1980; Boschma & Brownstein, 2016). For decades, realizing the promise of teaching with technology has meant rising to the challenges of supporting and investing in the technical

infrastructure needed: hardware, software, and Internet access (U.S. Department of Education, 2010).

While these challenges remain in some regions and geographic areas (File & Ryan, 2014), decades of policies and investment have begun to make inroads for technology into classrooms (Harper & Milman, 2016). Most recently, a combination of more affordable technology, cloud-based computing, and the migration of national standardized tests from paper and pencil into the cloud has brought a new wave of devices and Internet connection into today's public schools. In fact, the number of one-to-one Internet Communications Technology (ICT) initiatives is on the rise and becoming more and more ubiquitous across the nation (Grimes & Warschauer, 2008; Groff & Mouza, 2008; Schnellert & Keengwe, 2012; Strother, 2014).

New research shows, however, that just having access to ICT and the Internet does not guarantee access to 21st century skills (Dutt-doner, Allen & Corcoran, 2005). Differences in technology use in among students reveal a digital *use* divide—one characterized by differences between passive consumption and active production of digital learning objects such as blogs, websites, videos, and presentations (Asselin & Moayeri, 2011). Along with a variety of other factors, differences in students' technology use can vary based on socio-economic, educational, and cultural differences (Dolan, 2016; Lee, 2014). The manner in which these differences play out in student access is more complex and nuanced, often dependent on the degree of organizational focus on technology integration, especially among a number of competing priorities. While learning to use technology to learn and communicate grows in importance (Shin, 2014),

providing digital literacy instruction and practice continues to prove inconsistent (Leonard & Leonard, 2006). The digital use divide is emerging as a key educational equity issue in modern times.

As the digital use divide comes into focus, what becomes clear is that implementing technology in ways that support the “4 C’s of 21st Century Learning”—critical thinking, collaboration, communication and creativity—in ways that bridge the divide depends on more than just attaining the hardware and the Internet connection (Trilling & Fadel, 2009). Because of the constantly changing nature of technology, teaching with technology for 21st century learning highlights the need for teachers and organizations to become 21st century learners too (International Society for Technology in Education (ISTE), 2007; Meadows & Wright, 2008).

Implementation studies (Ensminger & Surry, 2008; Petko, Egger, Cantieni & Wespi, 2015), studies spotlighting successful integration (Herro, 2015), and case studies of individual teachers’ learning (Levin & Wadmany, 2008; Zhao, Pugh, Sheldon, & Byers, 2002)—all highlight organizational context as one of the most important factors that interacts with teachers’ skills, beliefs, and practices. Because of its link to these important factors, school context is a critical factor when teaching with technology in ways that bridge the digital use divide (Windschitl & Sahl, 2002; Staples, Pugach, & Himes, 2005). Schools function as systems, and today’s schools need to develop into learning systems (DuFour, 2004; Senge, Cambron-McCabe, Lucas, Smith, & Dutton, 2012) to support the complex task of integrating technology to bridge the digital use divide (Wong, Lee, Choi,

& Lee, 2008). Yet in the midst of today's onslaught of changes in schools (Ravich, 2016; Hayes Jacobs, 2014), how do seeds of such organizational change germinate and grow?

A body of research points to developing communities of practice such as professional learning communities (PLCs) as a pathway to changes in practice and even to changes in organizational leadership (DuFour, 2007; Hord, 1997; Robinson, 2008). When PLCs focus on learning outcomes, enable collaborative problem solving, and facilitate action in the classroom, they can be the impetus for changing beliefs and practices (Hord, 2007; Little, 2012; Spillane, Halverson, & Diamond, 2001). Bringing these two areas of research together, if context matters for technology integration, and if having a community of learners matters for technology integration, then technology PLCs may have the potential to focus organizational learning and serve as a seed of broader change.

But how? How do individuals and groups move from high-level goals for learning to the micro-tasks of planning and carrying them out? How is a learning community such as a PLC associated with teacher beliefs and practices, especially as they relate to student technology use? What aspects of the work involved in PLC participation help teachers to begin to innovate instructional practices in order to integrate technology use into everyday teaching and learning experiences? What types of context specific factors affect teacher collaboration, learning, and use of technology within a school?

Statement of the Problem

The digital divide is a concept that has evolved through the course of technology implementation in the United States. The digital divide describes the net differences in technology access and use across populations of students and communities in our diverse

nation. More recently, this construct focuses on national educational goals for technology *use* in addition to access in schools, highlighting gaps between updated goals compared with the range of existing classroom practices. By emphasizing the importance of planning and preparing for change in an equitable and rigorous manner for all, the digital *use* divide exposes some of the challenging, context-dependent aspects of meeting 21st century demands in our nation's schools.

In 2016, the National Educational Technology Plan (NETP) (U.S. Department of Education, 2016) was updated to reflect new understandings of the gaps between our nation's most current technology integration efforts and the goal of providing all students with a 21st century education. Recent data points to considerable progress in providing access to hardware and Internet connections in the growing number of places; technology is growing in abundance and becoming more readily available. Yet the updated standards now define and highlight a new digital use divide, characterized by differences in pedagogical practices related to technology integration. This newly identified divide differentiates between technology *implementation* characterized by passive digital content consumption and technology *innovation* resulting in active production of content. However, such productive use of technology, and the development of new digital literacy skills, is more likely to be experienced by students from higher socio-economic classes (Dolan, 2016; Lee, 2014). In this context, providing students with equitable access to pedagogical practices supporting active technology use defined by student voice, choice, and agency have emerged as the new focal point of the 2016 National Educational Technology (U.S. Department of Education, 2016).

Since federal, state and local policies first aimed to spur technology use in schools more than thirty years ago, implementation efforts and studies have led to deeper understandings of the complex factors affecting such innovations, leading researchers to focus in on the organizational level of change. More recently, studies have led to theoretical frameworks about school-level factors affecting technology implementation and innovation. Case studies using survey research have tended to focus on teachers' technology implementation experiences across a range of school contexts rather than within shared networks and organizations.

Even as frameworks and readiness tools recognize that administrators and teachers are the ones carrying out implementation initiatives, often without much preparation or training, few studies hone in on the processes involved in integrating technology mandates into visions guiding practice. Once resources are in place, school practitioners ultimately carry the torch and shoulder the burdens of realizing the nation's aspirations and goals for technology use through their daily decisions—planning, pedagogy, and practice. It is therefore critical to better grasp how teacher practitioners and school leaders might construct their understandings around technology use to shape and direct supports for technology innovations within their organizational contexts.

Within an organization, Professional Learning Communities, or PLCs, have been defined as communities of practice in which educators take collective responsibility for student learning, and interact in ways that inform and develop more effective practices (Horn & Little, 2010; Louis & Marks, 1998; Servage, 2008), sometimes distributing leadership roles in the process (Harris, 2008; Robinson, 2008) Even as standards-based

reform initiatives have spurred some debate about the most critical aspects of PLCs (Hargreaves, 2007), a review of PLC effectiveness (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006) concludes that “building PLCs is by no means easy” (p. 247), yet they “appear to hold considerable promise for capacity building for sustainable improvement” (p. 221). Horn and Little (2010) attempt to better understand ways improvements are realized by analyzing and comparing various teacher interactions within the contexts of teacher learning communities. In so doing, they identify multiple layers of influence that help to determine the extent that teacher interactions hone in on problems of practice to deepen teacher pedagogical understandings.

Technology implementation research points to the need for schools to develop new technology skills in conjunction with student-centered pedagogical practices. Thus, the types of ICT integration are dependent on the school context and capacity to support technology learning and innovation. For these reasons, studying the processes and interactions of a tech PLC can provide new insights on the potential impact that the familiar structure of a PLC might have on developing and supporting effective technology integration in for 21st century learning.

Purpose of the Study

Given that the thirty-year experiment of technology implementation has led to a focus on the school and non-material context factors largely contributing to an emerging digital use divide, how can schools support important understandings and practices to leverage the technology they have recently acquired? The purpose of this study is to examine and describe ways in which a PLC contributes to developing teaching practices aimed at

addressing the digital use divide. It does so within the context of a school with a one-to-one digital device program serving a student population where more than 60% qualify for free and reduced lunch. From this environment of available technology resources, a student population that is vulnerable to the digital use divide, and a staff that regularly uses Professional Learning Communities to support learning in the content areas, this case study examines teacher participation and processes involved in a new PLC specifically organized around technology implementation as the school aims to develop a technology-based program of choice within the school district. It aims to answer the following questions.

1. How is participation in a technology PLC associated with teacher beliefs and practices related to addressing the digital use divide?
2. What are the aspects of the PLC that facilitate teachers' innovative practices related to addressing the digital use divide?
3. What are the interactions between school-based context factors and teacher collaboration and learning in the PLC?

Examining a technology-PLC's process through these lenses may point to potential avenues for enhancing a school's capacity to innovate in the current time of change.

As a descriptive case study of a public school in the midst of defining a program of choice specializing in teaching with technology, this case study takes a positioned-subject approach combined with principles of autoethnography (Theoharis, 2007). As the principal of the school with insider knowledge of the processes and relationships leading to this critical moment of school identity change, the primary researcher includes self-

study as a part of the methodology. This allows access to “insider knowledge” of the context under study (Herr & Anderson, 2015) while also “attempting to understand how practitioners learn their craft” (p. 32). In an attempt to mitigate some of the inherent power dynamics involved in participatory action research with those one supervises, selection criteria and researcher participation guidelines were proposed and further developed with input from the study’s teacher participants (see chapter 3 for details).

Through a technology context and use survey completed once by the school’s staff and twice by the tech PLC participants for pre-post comparison, a post PLC participation survey for study participants, observations and audio-recordings of the tech PLC meetings, conversations around student work samples generated through participation in the tech PLC, and follow up interviews with three of the tech PLC participants, this case study looks to describe how teachers collaborated in a tech PLC and how such a PLC affected teacher beliefs and practices related to addressing the digital use divide within a shared organizational context.

Definition of Terms

- Digital Divide: describes the difference in access to technology—including hardware, software, and Internet connectivity that is affected by sociocultural factors such as race, ethnicity, income, and educational background.
- Digital Use Divide: describes the differences in the use of technology, characterized either as active or passive, that has been linked to sociocultural factors within and across schools. Active use is characterized by creativity, collaboration, critical thinking, or communication purposes. These support the

development of new digital literacy skills. Passive use of technology is more likely employed in support of rote memorization or drilling of basic skills, watching video information, and whole class participation in more traditional learning contexts.

- Information Communication Technology (ICT): applications that use the Internet to allows the class, individual students, or the teacher to each other, to outside resources, or outside audiences.
- Professional Learning Community (PLC)—a group of teachers coming together for a cycle of goal setting, data collection, planning, implementation and reflection to guide professional growth and future teaching practices.
- Program of Choice—a specialized program within a school which is open for enrollment of students from other schools in the same district. These are similar to magnet schools.
- Technology innovation: Implementation of technology in experimental ways that involve changes in teaching style, management, practice, or tools in order to increase student engagement, skills, or agency.
- Technology integration: the use of digital devices or ICT in facilitating learning of content or content-related skills as opposed to as a separate computing class.
- Tech PLC—a professional learning community focused specifically on technology integration through collaborative technology innovation focused on student outcomes.

Significance of the Study

At the heart of implementing technology for relevant and rigorous learning is the challenge of creating an organizational context that can support the continuous learning and risk-taking involved in such an undertaking. Identifying impactful aspects of PLCs may provide school leaders with insights about building learning organizations that can help to bridge the digital use divide and pave the way to a more equitable and promising future for all students. Bridging the digital use divide promises to empower vulnerable groups of students to learn about and participate in the broader community with the knowledge, skills, and actions that will be most relevant to their futures.

In this chapter I have introduced the evolving digital divide, its significance, and lessons learned about the challenges of implementing technology in ways that can bridge this divide. Since PLC practices have been linked to supporting and building learning organizations, they hold potential to not only support individual learning necessary for meeting the modern challenges of technology innovation, but may also provide information about the context specific factors that affect successful technology integration into teaching. In summary, the purpose of this study is to examine and describe one technology PLC and how participation in the PLC is associated with teacher beliefs and practices related to addressing the digital divide; it provides an opportunity to explore technology reform through the common practice of PLCs in a way that can take into account context specific factors and interactions. Insights into how these factors and interactions affect PLC processes and teacher practice may provide implications for leadership and change in schools for the future that is already here.

Chapter Two

Literature Review

Overview

Integrating technology into school learning environments equitably has been a long-term goal of educational reformers. Thirty years of reform efforts demonstrate the complexity of implementing change in schools. This seemingly simple goal has somehow proven elusive. Results and lessons from decades of educational technology policy and implementation illustrate how educational progress is “closer to the path of a butterfly than the flight of a bullet” (Cuban, 2013, p. 119). The pathways from policy to practice entail navigating change through a “complex, dynamic, and yes, messy, multi-level system” (p. 115). Without clearer understanding of critical aspects of this complicated process, school reform goals such as teaching with classroom computers are destined to remain merely *oversold and underused* (Cuban, 2009). Meanwhile, neglecting the gap between the promise and practice of educational technology in today’s information economy neglects vulnerable groups of students. Left to their own devices, these students may slip through this gap, perpetuating inequality.

An evolving digital divide in the United States describes an unequal continuum of access against a growing backdrop of poverty in America and its public schools. In this context, technology access has been defined in terms of the availability of devices and Internet connection in homes and schools. More recently, access is also being defined as how students are using technology. Depending on students’ socio-economic status, they are likely to be using technology in very different ways; passive consumption of digital information characterizes the experiences of more vulnerable populations while active

production of media is likely to characterize the experiences of privileged groups of students. These differences define the new digital *use* divide, and they have become the focus of integrating technology equitably in schools. Ironically, school accountability policies may inadvertently contribute to the digital use divide by prioritizing tested content to the detriment of other areas for learning. The digital use divide is the newest iteration of inequality among a long history of inequalities in America's schools, adding to a legacy of educational debt to historically neglected populations. Yet pockets of practice underscore technology's largely untapped potential for accelerating students' learning and growth, especially for marginalized, vulnerable groups of children.

It is because of technology's promise in its capacity to reach, engage, and prepare students for modern opportunities that it has been a long-term goal for education in the United States. Over the past thirty years, the policies, politics and approaches to trying to get digital devices into schools have shaped different eras of reform. Each era has been shaped by its own drivers and resulted in lessons learned for the next wave of reform.

Along the long road to technology integration, many lessons have been learned about what's needed to bring innovative uses of technology into classrooms. Access to devices serves as a foundation, followed by teacher technology skills and pedagogical practices. Because integrating technology in meaningful ways requires shifts in teaching, communities of practice offer important support beyond traditional avenues for professional development. The conditions for classroom technology innovations increasingly include more than just providing teachers with technology and training. The fast-paced changes involved in teaching and learning with technology require aligning

support across the school context that enable practitioners to evolve with ongoing developments.

A modern understanding of how schools must adapt and evolve has contributed to the concept of schools as learning organizations. As complex systems with specific goals, values, and independent agents working within, schools receive and affect change initiatives according to the contextual factors of each system. Empirical evidence from studying technology innovation has shown that undertaking such innovation involves taking into account specific organizational and contextual factors, their interactions, and potential drivers and barriers to the change within each context.

Within the school system, professional learning communities hold potential as leverage points for self-organization and adaptation. If professional learning communities can keep their collective focus on teaching for learning, if they can problem solve to reinvent practices, and if they can adapt to and influence the larger organizational system, professional learning communities may be an avenue for planting and growing sustainable technology integration to bridge the digital use divide.

The Evolving Digital Divide—A National Continuum of Access and Usage

The landscape of device ownership and Internet connectivity has evolved dramatically over the last fifteen years, revealing a narrowing digital divide in some areas while exposing a widening gap in others. Census surveys of home connectivity and teacher surveys of school resources help to shed light on the emerging topography of technology use in the United States. What is clear is that socioeconomic status plays multiple roles in influencing students' out-of-school and in-school access to and use of

technology. Reviews of recent research on educational technology implementation (Harper & Milman, 2016) and updated educational technology policies (U.S. Department of Education, 2016) indicate ways in which the digital divide has splintered and shifted—from a sharp rift between “haves” and “have-nots,” to increasingly intricate differences in the ways in which children use technology (Dolan, 2016). The shifts and fissures in the digital divide continue to follow the fault line of economic differences across the nation. Potentially hidden or overshadowed by the many initiatives and policies driving school reform today, students’ access to and use of technology continues to evolve, whether schools address and teach technology use or not.

Poverty in American schools, a growing status quo.

Over the past thirty years, global economic changes have aligned to redefine standards and conceptions of college and career readiness; educational policy makers have set the nation’s sights on preparing economically competitive graduates to enter the labor market (Culp, et al., 2005). During this same time period, schools in the United States have become increasingly segregated by race and economic status. An analysis of student demographics in the one hundred largest cities in the United States reveals a new status quo of concentrated poverty reflecting systemic economic and racial isolation; in almost all major American cities, most African American and Hispanic students attend public schools where a majority of their classmates qualify as poor or low-income (Boschma & Brownstein, 2016). As “average student achievement is inversely correlated to concentrated disadvantage” (Ang, 2014 p. 5), the cumulative academic achievement effects of this growing isolation looms as a growing obstacle for efforts to make quality

education available to all students (Boschma & Brownstein, 2016). Nationwide, the share of school children who qualify for free or reduced lunch crossed the 50% threshold in 2013, compared to fewer than 32% in 1989—and testing data over the past ten years highlight a persistent achievement gap for these students (Luhby, 2015).

In California, 72% of students attend schools in which over half of the students are socio-economically disadvantaged as defined by state funding policies aimed at supporting vulnerable groups of students such as low-income, English learner and/or foster children. Student achievement varies by such factors, and SAT scores vary even more closely. According to Ang (2014), approximately 73% of California SAT score variations in 2013 could be predicted based on school districts' concentrations of vulnerable student groups. Even as policy makers restructure funding requirements to support vulnerable groups of students, the numbers of students in need have expanded and continue to grow. These changes factor into learning needs and considerations of students served within the context of each school.

Technology access: haves and have-nots.

Internet use and computers permeate all major aspects of modern societal life. From our jobs to our learning, from entertainment to healthcare, from professional networking to more intimate social relationships, we have grown to rely on Internet Communication Technologies (ICT). Recent United States Census statistics confirm continual upsurges of computer ownership and Internet use over time. For example, while only 8.2 percent of all households had a computer in 1984 and 18.0 percent reported home Internet use in 1997, 2013 census survey data estimate that computer ownership has risen to 83.8

percent, and home Internet use to 74.4 percent of American households (File & Ryan, 2014).

Devices and connectivity in homes. Despite the growing ubiquity of ICT, device ownership by individuals and households still vary. Technology flows according to differences in age, race, ethnicity, income, and education. Household computer ownership and Internet use tend to be highest among the young, Whites and Asians, the affluent, and the highly educated (File & Ryan, 2014, p. 2). Computer ownership ranges by race: from 90% for Asian households, to 81% for White, 70% for Hispanic and 66% for Black households. Internet connectivity follows a similar pattern; 87% of Asian households have some Internet subscription, 77% of White, 67% of Hispanic, and 61% of Black households (p. 3).

Not surprisingly, individuals and households that are least likely to own computers or subscribe to Internet connection have the highest rates of exclusive reliance on handheld devices; younger ICT users (between 15-34 years old), Black and Hispanic ICT users, and those earning less than \$25,000 a year rely solely on handheld computers for access—at rates of about 9 percent. Put into the context of use, only 49% of families making less than \$25,000 a year reported accessing the Internet at home compared to 96% of those making over \$100,000 per year.

Geographic patterns of access vary widely across the United States and within individual states. States with statistically higher rates of computer ownership and Internet use tend to be located in the northern and western regions of the United States. Within states, patterns of access and use vary based on community characteristics and local

provider availability. California serves as an example of such wide variability across cities and regions; overall, it ranks 18th in computer ownership and 17th in Internet use among all the states (File & Ryan, 2014).

Devices and connectivity in schools. Public school access to educational technology shows similar patterns of differential progress. While computers themselves are not new—having seeped into classrooms as early as the 1990’s (Cook, 2015)—major shifts in policies and assessments have triggered a wave of ICT implementation across schools and classrooms. According to 2009 teacher-level educational technology surveys by the National Center for Education Statistics, 96% of all classrooms were connected to the Internet. Yet the data illustrated that “connected” had a range of meanings, with variations in the number of devices connected, whether they were in classrooms or labs, and differences in who had access to them (Gray, Thomas & Lewis, 2010).

Driven by new Common Core standards and computer-based testing, ICT has been increasing in classrooms to accommodate online, computer-based accountability tests, widely launched in the spring of 2015. These testing requirements and more affordable prices have caused a surge in web-based digital devices in classrooms across the country. Schools are pouring resources into complying with mandated computer-based student achievement tests, and students are gaining access to school-based technology. The student-to-computer ratio was about 12.1 students to each instructional computer with Internet access in 1998 (Cook, 2015), and rose to 5.3 students per computer in 2009 (Gray, et al., 2010). A 2013 national survey on student technology access reported that

31% of students in grades 3-8 had access to tablets or laptops provided by the school and that the majority of these students were allowed to take the devices home (Nagel, 2014).

This rising tide of technology is increasingly ebbing from computer labs and flowing towards classrooms. As schools and districts look to expand 1:1 technology initiatives, two-thirds of school systems reported in 2015 that their WiFi could handle 1:1 initiatives—up from 54% in 2014. Respondents predicted that the numbers of student devices on their networks would dramatically increase over the next three years (Consortium for School Networking, 2016). As the technology surges, developing infrastructure, hardware, and professional capacities to match will continue to shape access and equity in schools.

New Equity Focus: the Digital Use Divide.

Ten years ago, the International Society for Technology in Education (ISTE, 2007) published standards for integrating ICT, digital tools, and media to support students' skills for finding, synthesizing, creating, and communicating their learning in the increasingly wide world of the Internet. The United States Department of Education's (2010) National Educational Technology Plan first focused on aligning and updating standards for "21st-century competencies" (p. xi), building up school infrastructures and access to computers and the Internet, designing aligned technology-based assessments, and connecting educators to collaboratively leverage technology to improve instructional practices and learning outcomes (p. xii).

Six years later, the newest version of the plan (U.S. Department of Education, 2016) redefines the digital divide, not as just one of access to hardware or the Internet, but also

one of access to types of uses of technology for higher order, critical thinking and engagement. Newly coined the “digital use divide” the 2016 National Educational Technology Plan update acknowledges progress over the last five years.

The conversation has shifted from *whether* technology should be used in learning to *how* it can improve learning to ensure that all students have access to high-quality educational experience. (p. 5)

Then it turns to the work ahead based on the new definition of the digital divide.

A digital use divide continues to exist between learners who are using technology in active, creative ways to support their learning and those who predominantly use technology for passive content consumption. (p. 5)

After a decade with the 2007 ISTE standards serving as a goal and vision for technology implementation, after five years of rapidly changing educational technology landscapes, research suggests that without explicit focus on equitable integration, technology use may be overshadowed by more prominent environmental influences in schools and communities.

SES and the digital use divide. An emerging body of literature highlights the fact that computers in classrooms don’t always improve education in the ways intended. In fact, there are unintended consequences of technology in the classroom (Coughlan, 2015; Harper & Milman, 2016). The ways teachers use technology make the difference between merely substituting traditional practices with digital forms and using technology to transform teaching by facilitating students’ active construction of new understandings (Dolan, 2016; Groff & Mouza, 2008; Gundy & Berger, 2016; Lin, Wang, & Lin, 2012; Staples, Pugach & Himes, 2005; Tarling & Ng’ambi, 2016; Zhao et al., 2002).

A national survey of teachers' use of educational technology in U.S. public schools conducted by the National Center for Education Statistics (Gray et al., 2010) showed that differences in the frequency, type and purpose of technology use were related to differences in socio-economic status, cultural background, and community resources. Whereas 61% of low poverty concentration schools used educational technology during class to learn or practice basic skills sometimes or often, 83% of high poverty concentrations schools did. On the other hand, 47% of low poverty schools had students develop and present multimedia presentations compared with 36% of high poverty schools (Gray et al., 2010, pp. 3-4). Gray and colleagues' dissection of technology use offered examples of how teacher technology use varied across different socio-economic populations. Together, the data illustrate that there remains room for all schools to develop innovative practices that integrate technology for active learning.

Patterns of student technology use reveal that low socioeconomic status schools tend towards using technology for reinforcing and remediating skills more often while higher socioeconomic status schools are more likely to use technology for presenting and analyzing information (Schnellert & Keengwe, 2012; Windschitl & Sahl, 2002). This pattern has been replicated and described even in the technology hub of the San Francisco bay area (Lee, 2014). In a survey study comparing high school teachers' technology use in high socio-economic status schools with low socio-economic schools, Lee found significant differences in Internet access, regularity of ICT use, and uses of ICT to support higher order cognitive tasks (as opposed to remediation of basic skills). The digital use divide was clear. "Students, specifically African American and Latino students

from low-SES backgrounds, rarely used ICT to control the process in which information was applied, created, evaluated, or analyzed” (p. 121). Meanwhile, “for the most part, teachers at the participating high-SES schools in this study are implementing goals that match the technology standards...” (p. 124).

Both local and national research and policy initiatives now recognize that unequal patterns of technology use contribute to opportunity gaps. In her review of over 100 empirical studies, theoretical articles, research reviews, and government surveys published between 2005 and 2015 about technology use in American K-12 public schools, Jennifer Dolan (2016) highlights the digital use divide as a key factor driving inequity in education. She warns that the integration and use of technology in schools currently follows an “opportunity gap” pattern, or “school practices that reinforce and often exacerbate inequity such as low expectations by teachers or misunderstandings due to cultural differences” (p. 32). Whether teachers are challenged by their students’ academic needs or struggle to bridge and leverage diverse cultural backgrounds, socio-economic differences in school technology use have emerged as an important area for further investigation and understanding.

Accountability policies may exacerbate differences. While teachers play a major supporting or limiting factor on how students use technology, external factors such as policies, standards and accountability issues also play a role (Dolan, 2016). In a review of one-to-one technology use in K-12 classrooms across the United States, Harper and Milman (2016) found that, “Overall, students’ use of technology was influenced primarily by the teachers’ experiences with technology and the curricular and

instructional demands teachers faced” (p. 139). Context dependent curricular demands such as high-stakes accountability measures impact teachers’ sense of having enough time or flexibility to incorporate more innovative uses of technology.

This influence holds true even across nations. Differences in testing pressures also played a role in technology implementation in Wong et al.’s (2008) case studies of elite and non-elite schools in Hong Kong and Singapore. Researchers explored teachers’ resistance to incorporating ICT in more “innovative” or constructivist ways of teaching and found that resistance was amplified by the pressures and demands that national examinations placed on teachers struggling to teach all the standards to students who needed additional support. Across eight schools selected for the study, “constructivist” “student-centered” practices were only noted in the “elite” schools or those “with restrictive admissions criteria and a highly selective reputation to match” (p. 252) even though pedagogy was not an a priori school selection criteria. Similarly, it may not be surprising that access to technology and uses described as “productive” by the 2016 NETP first appeared in private and independent schools in the United States (Windschitl & Sahl, 2002), before computerized accountability measures more recently focused attention and resources on bringing technology into public schools (Atkinson & Swaggerty, 2011; Schnellert & Keengwe, 2012; Steiner-Adair, 2015).

Inequality in America’s schools: a legacy of educational debt exacerbated by deficit views inherent in accountability movement’s focus on achievement gap. The conflict between educational reform ideals—such as technology integration—and the sobering reality of its often-unequal outcomes arise from “unique organizational characteristics of

a tax-supported public bureaucracy governed by lay policymakers” and “the imperative to retain the loyalty of both constituencies” (Cuban, 1990 p. 10). In struggling to meet the demands of both social reformers, who aim to ensure an equitable playing field, and public “consumers,” who view education as a private commodity for individual betterment (Cuban, 1990; Labaree, 2012), schools must navigate and negotiate the intended and unintended consequences of change in the midst of enacting it from within a political context.

The complex relationship between the educational institution and the dynamics of class relationships (Bowles & Gintis, 1976) are legacies of a system of mass education, which was born of the Industrial Revolution. Its structural inequities have been expressed through the teaching of differing skills determined largely by students’ socio-economic levels according to social class expectations and resources (Anyon, 1980). The digital divide resonates with these same structural inequities.

Meanwhile, students grow more diverse, and practitioners struggle to meet the challenges of adapting to 21st century learning goals in classroom contexts where students increasingly come from backgrounds unlike their teachers. As educators grapple with these changes, accountability policies prompt them to view differences in student performance as an “achievement gap” requiring urgent remediation.

Ladson-Billings (2006) challenges the nation to recognize that it is an accumulation of disparities in economic, social, political opportunities: an accumulation of disparities in investments throughout America’s history—what she calls the “education debt”—that better explains the academic progress of underserved minority students. Only when the

education debt is addressed through equitable investments and opportunities can educational progress and “the potential for forging a better educational future” have a chance of success. She argues that enriching student’ experiences, rather than filling their deficits, is the lens that is needed to address our students’ true needs.

The bottom line: school practitioners serve both constituencies in a system that has traditionally identified students’ needs as gaps within an increasingly market-based consumer context, which demands enriching and meaningful opportunities for children. The relative pull of each constituency and legacy is context-dependent for each school, posing unique challenges for practitioners to make sense of, navigate and negotiate based on the shared values and mission of each organization.

Effects of teachers’ perceptions of students on bridging the digital use divide. If, as Ladson-Billings suggests, we reframe the achievement gap as an opportunity gap to be addressed, the call for teachers to integrate digital communication tools in a digital age has uncovered another potential opportunity gap for students to develop online skills and interactions. All students benefit from explicit instruction and opportunities for practice when learning new skills. Without guidance, even students in well-resourced independent schools demonstrate inexperience, naiveté, and dual-identities between their online and offline interactions (Steiner-Adair, 2015). In fact Steiner-Adair implores, “What is clear from my work with students in elementary, middle, and high school is how hungry they are for their teachers to teach them pro-social strategies for dealing with these difficult social dynamics—online and *irl*” (*in real life*) (p. 38). Research from the field of computers in education echo the need for scaffolding and supporting students’ social

interactions—for developing effective learning communities (Kreijns, Kirschner, & Jochems, 2003) and to develop the confidence and control needed for cognitive, social, and emotional development when using technology for learning (Jones & Issroff, 2005).

Yet while emotional competencies and understandings turn out to have broad-ranging implications in shaping new digital learning contexts, classroom interactions and expectations can be influenced by students' and teachers' different individual and cultural experiences. In his study of the role of emotions of teaching and educational change, Hargreaves (2000) highlights a “disturbing neglect of the emotional dimension in the increasingly rationalized world of educational reform” (p. 811). In his intensive interviews with 53 teachers responses to educational change, Hargreaves finds that while elementary teachers in particular were motivated by the psychic rewards of strong classroom relationships, they were also more susceptible to negative emotions from frequent, close and intense contact with students. He introduces the idea of teachers' and students' various “emotional geographies”—individual and cultural experiences of human interactions and relationships that color our feelings and emotions about ourselves, the world, and each other—and finds that large differences in emotional geographies can contribute to misunderstandings between teachers and their students that can significantly impact the learning environment.

If any emotional geographies pose risks to consolidating...emotional understanding, these are the geographies of political distance where power differences between teachers and students can lead to active dislike and rejection in the emotionally intense environment of the elementary classroom. (p. 824)

Based on Hargreaves' findings, at worst, emotional, political and cultural differences can lead to alienation of students from the learning environment. In lesser cases, it can lead to merely lowered expectations for these groups—the kinds of expectations that keep struggling students' use of technology as passive consumers working on basic skills in isolation from other learners, especially when accountability policies place a priority on test score results.

A historical examination of the “mismatch” between students and educators with social power reveal a long history of alienation, lowered expectations, and lower academic performance by students whose backgrounds have differed significantly from the mainstream (Deschenes, Cuban & Tyack, 2001). “Historically, students, families, inefficiency in schools, and cultural differences have been identified as sources for failure” (p. 534).

Critical race theorists such as Valenzuela (1999) and Yosso (2005) connect low expectations of specific groups of students to the students' lack of cultural capital in the school social structure. Valenzuela's 3-year ethnographic study of Mexican youth experiences of high school in a community in Texas illustrates how the lack of teacher-student relations to bridge cultural differences lowered teachers' expectations as they viewed students through a deficit lens. These expectations and interactions played out in students' everyday experiences of school as a “subtractive” experience.

In response to such a deficit lens that is too-often based on race or ethnicity, Yosso (2005) draws on tenets of Critical Race Theory to shift the focus towards uncovering and emphasizing communities' cultural wealth in ways that can “empower People of Color to

utilize assets already abundant in their communities” (Yosso, 2005, p. 82). Critical race theorists pose an important argument; educators need to combat deficit views of students through a “wealth”—or strengths-based—perspective and develop strong teacher-student relationships to positively impact teachers’ perceptions and expectations of students who may come from different backgrounds and ethnicities.

Classroom research supports the practical benefits of this argument. Jennings & Greenberg’s (2009) model of a prosocial classroom draws from literature providing evidence that highly self-aware, culturally sensitive, and social-emotionally competent teachers can facilitate effective learning environments for a range of diverse learners.

When teachers are warm and supportive, they provide students with a sense of connectedness with the school environment and the sense of security to explore new ideas and take risks—both fundamental to learning. (p. 500)

Combatting the idea that certain groups have more valuable norms of behavior and interaction—regarded as social capital in the school context—makes room for explicit teaching and shaping of positive interactions in face-to-face interactions and through those facilitated by ICT within such learning cultures (Coffey, 2012; Turner, Hayes, & Way, 2013). This type of explicit teaching and support serves as a critical foundation for the type of student-centered technology integration that may begin to bridge the digital use divide.

Opportunities for Equitable Technology Integration

New national goals for addressing the digital use divide aim to align industry and education to provide students with equitable opportunities to use technology in support of rigorous and relevant learning for the 21st century. Doing so has shown promise in

benefiting all students, especially students from traditionally more vulnerable populations. Where equipment and connectivity are made available, and where instruction emphasizes higher order thinking skills, ICT integration has been shown to accelerate academic achievement for minority students and students of lower socio-economic backgrounds in the United States (Grimes & Warschauer, 2008; Larson, 2009; Mouza, 2008) and abroad (Jesson, McNaughton & Wilson, 2015).

In a two-year implementation study across six New Zealand schools serving culturally diverse students from low socio-economic communities, Jesson, McNaughton, and Wilson (2015) worked with a cross-site professional learning community to identify defining qualities of Effective Classes in terms of integrating digital devices to raise literacy levels. They found four major differences. These included 1) increasing teacher interactions to support deep thinking (such as comparing multiple digital sources to synthesize and evaluate information); 2) creating digital learning objects (DLOs) such as videos, blogs, and presentations which 3) promote information literacy and critical literacy; and 4) increasing students' knowledge of features of subject-specialized and multi-modal texts. When the identified practices were brought back to the individual sites through school-level Professional Learning Communities (PLCs) in the second year, the linking of higher level thinking skills to new digital pedagogies resulted in accelerated progress in writing for vulnerable populations.

Research on implementing such inquiry-based, productive use of technology has been shown to heighten engagement and learning for the most vulnerable students by helping teachers engage with and perceive their students in new ways. Shin's (2014) study of a

second grade English Learner who used blogging for social and academic purposes showed how blogging with classmates and family members leveraged and built social relationships to support the students' sense of self as well as his emergent literacy and digital literacies. Meanwhile, Mouza's (2008) quasi experimental mixed methods study of a one-to-one laptop program in 3rd and 4th grade classes in an under-privileged school in New York found that, "in the hands of well-prepared teachers," technology demonstrates the "potential to bridge the digital and didactic divide" (p. 469).

Compared with control classes in the same context, laptop use increased student motivation, time doing schoolwork, while also facilitating increased interactions with peers and teachers. These factors empowered students by fostering self-confidence in their academic abilities, and the study found that technology integration fostered academic gains in writing and mathematics. Equitable integration was supported as teachers reflected on recognizing their own roles as learners and their students' abilities to learn skills quickly. This allowed teachers to leverage students' learning and increasing expertise to even provide teachers with tech support (Mouza, 2008).

The Call for Technology in Education in the U.S.: Historical Overview

Since the publication of *A Nation at Risk* (1983) first recommended including computer science as one of the "Five New Basics," the goal of bringing computer technologies into schools has driven government partnerships, consortiums, and policies. In a review of 28 key policy documents produced between 1983 and 2003, Culp et al. (2005) identify three recurring reasons for focus and investment in technology policies that still fuel policies such as the NETP (2016) today. These purposes permeate the

educational technology literature while also reflecting the changing tone and language of the politics and policies of the times.

The rationale for technology in education. Technology has been long regarded by government and business as a critical factor for maintaining the United States' economic competitiveness in the world (Culp et al., 2005). With the advent of the information society, scientific and technical advances, and the globalization of the economy, the United States' education agenda has evolved to both shape and embody a global education agenda (Baker, 2014), along with its associated discourse about job preparation, economic development, and multiculturalism (Spring, 2014). This global education agenda has fueled the focus on integrating ICT in education (Kay & Greenhill, 2013; Wong et al., 2008) informed standards for technology integration (ISTE, 2007), primed goals for 21st century skills (Trilling & Fadel, 2009), and coalesced into Common Core Standards along with aligned computer-based assessments (Darling-Hammond, 2010). In order to and engage in meaningful and productive communication today, “modern literacy instruction is vital for preparing students for the 21st century world, whether it’s for a career or for higher education” (Hayes Jacobs, 2014 p. 52). In short, public discourse warns that ignoring critical ICT competencies will put the future U.S. workforce in danger of being left behind.

With its fast-paced changes and improvements, technology has also held the promise of addressing many of the challenges in teaching and learning. “Many educators looked to technology as the savior of an educational system regarded by many as being in a state of crisis” (Hasselbring & Tulbert, 1991, p.1). Technology promises access to information

that can overcome the challenges of geographically dispersed learners (Schnellert & Keengwe, 2012), support complex analysis of data (Culp et al., 2005), and broaden the scope and timeliness of information in the educational system (Darling-Hammond, 2010).

Perhaps most importantly, the integration of ICT has been regarded as a potential change agent for educational practice (Culp et al., 2005). Technology promises to make learning more relevant and engaging by bringing more of the outside world into the classroom (Moore, 2013; Raddaoui, 2012). It can impact the teaching and learning process by personalizing learning (Bruce & Casey, 2012), allowing for more constructivist or inquiry-based practices (Hagerman & White, 2013; Harper & Milman, 2016; Raddaoui, 2012; Solomon & Schrum, 2007), and making traditional subjects such as writing more collaborative and participatory (Pow & Fu, 2012, Sorapure, 2010). While hopes for technology integration have been realized in some contexts outside of school (Calderón, 2009; James & Hull, 2007; Scott & White, 2013), widespread innovative implementation as anticipated has proven more challenging (Dolan, 2016; U.S. Department of Education, 2016; Harper & Milman, 2016; Schnellert & Keengwe, 2012).

Policies, politics, pitch: changing drivers of reform. Policies driving educational technology implementation have evolved within broader contexts of politics and school reform; plans and standards emerge from and reflect the changing discourse and ethos surrounding school reform. By 1995, thirteen years after *A Nation at Risk*'s urgent call for school reform and policies to leverage technology integration into education, the Internet emerged as a rapidly expanding tool capable of driving unprecedented changes across business and education sectors. In contrast, the integration of educational

technology into schools paled as slow and inconsistent. The stark contrast between educational innovation and innovation in the private sector led to a change in tone of policy reports from the federal government (Culp et al., 2005). “During this period, policy reports begin to present education technology as a driver of school reform, rather than as a class of tools and resources...teachers are now framed largely in terms of what they are *lacking*.” (original emphasis, Culp et al., 2005, p. 301). Soon after this period, the *No Child Left Behind* (NCLB) Act was signed into law in 2001, leading an era of accountability, market-based choice programs (Glass, 2008) and a “deprofessionalization of teaching” (Barrett, 2009).

However, mounting evidence suggested that technology in and of itself did little to drive improvements in teaching and learning, and the political tide turned again as focus shifted towards examining technology implementation and use in light of diverse practitioner and organizational contexts (Culp et al., 2005). This move towards supporting teachers and school leaders through change coincided with the release of ISTE Standards in 2007, which describe student competency goals, provide sample projects, and point to organizational factors needed to support implementation. The first National Education Technology Plan (NETP) followed in 2010 and aimed to align structural supports to the proposed standards and goals—twenty-seven years after the initial call for bringing technology into education. Today’s updated version (NETP, 2016) focuses on classroom use, equity, and empowering students, teachers, and school leaders.

The politics and policies of technology integration have reflected the educational progress and ethos of the times. Uncovering and exploring the many challenges to

implementation has implications on research, practice, and new policies. The long journey from the promise of technology to its practice continues into the next iteration of the country's learning process.

Lessons from Implementation: Drilling Down to Practices

As the “rubber meets the road” of getting technology into classrooms, lessons are learned through encountering challenges and obstacles. In examining calls for digital technology use in schools, Selwyn (2010) argues that “a general reluctance to acknowledge the complex social structures that influence even the most innocuous application of technology in the classroom” impedes educators on the path towards realizing those calls for technology integration (p.ix). Decades of experience uncovering barriers have led to new understandings about the impact of different adoption strategies and about a variety of teacher readiness progressions, leading to an emerging understanding of the complex conditions that shape organizational context and change when integrating new technologies for teaching and learning.

Adoption strategies—aligning resources, leadership, and support. More than 50 different models for studying innovation from the perspective of implementation have been developed or studied in the context of educational change. These include a continuum of teacher decision-making and involvement—from top-down, externally motivated models, to internally-imposed bottom-up dynamics (Gundy & Berger, 2016).

While research has suggested that innovation processes in schools are more successful when they are participatory and voluntary (Petko et al., 2015; Mouza, 2008), when it comes to digital media adoption, the need for technology played a key role in

successful innovation efforts. Petko and colleagues' (2015) study of fourteen Swiss schools going through technology adoption examined their levels of success from the lens of the direction and impetus for change. Schools were viewed as a complementary top-down and bottom up (type 1), exclusively top-down (type 2), exclusively bottom-up (type 3), or neither strongly bottom-up nor top down (type 4) model of adoption.

Through survey data from administrators, teachers and students, the researchers confirmed their prediction that schools with combined top-down and bottom-up drivers for adopting digital media would result more successful adoption. Success was measured by ICT resources, teachers' professional development activities, ICT use, ICT skills, positive beliefs regarding ICT by teachers and by students. Surprisingly, Petko and colleagues found that top-down schools in their study achieved similar levels of adoption as the combined top-down and bottom-up schools. However, the exclusively bottom-up innovation schools did not achieve the same level of integration. This study highlights the importance of resource alignment; bottom-up drivers had fewer computers compared with other types of schools, which negatively impacted outcomes. Petko and colleagues concluded that while teacher motivation is an important driver for change, top-down alignment in providing resources and support were critical for digital media adoption.

While strong top-down support may "even instigate bottom-up responses" (Petko et al., 2015 p. 56), the absence of leadership is a clear detriment to implementation. In a survey study of 214 schools in North Louisiana ranging from grades K-12, almost all respondents (97%) indicated that technology integration was important for effective teaching and learning in their schools. However, 87% of the school-based administrators

indicated that they needed to know more about how to effectively integrate technology into the teaching and learning process (Leonard & Leonard, 2006). The authors conclude, “quality technology integration in schools is likely to be determined largely through the caliber of the leadership directed to sustain it,” but “may continue to remain largely absent or essentially illusory” (p. 223). Bobbera’s (2013) study of the effect of technology professional development for “twenty-first century principals” resulted in measurable technology integration and student engagement differences at the sites of administrators included in the training series.

Resources are critical; they are also gradually becoming more available. Meanwhile, aligning technology educators’ visions of *how* to teach with technology remains one of the most challenging aspects of educational technology integration. What’s more, the emerging digital use divide challenges educators to facilitate quality learning opportunities for all students. Doing so requires learning across multiple levels. Educators must design and evaluate learning experiences based on content and technology standards. As they move away from seeing themselves as content experts and towards accepting new positions as co-learners (Herro, 2015; Mouza, 2008) educators must learn to guide, facilitate, and motivate learners to access and interact with ICT in an Information Age (Coffey, 2012; Staples et al., 2005). This shift also requires learning appropriate technical skills (NETP, 2016). As the many learning requirements for integrating education technology have come to light, so have frameworks for describing and measuring ICT integration at the level of the teacher.

Teacher progression models point to learning in context. Because different levels of ICT implementation have been linked to teacher beliefs and practices, learning-oriented models of technology integration focus largely on teachers' pedagogical concerns about innovation. These include adaptations of innovation-diffusion theories from the pedagogical and curricular perspective such as the Concerns-Based Adoption Model (Hall & Hord, 2015) for technology integration, as well as others based on computer science-based models of adoption (Gundy & Berger, 2016; Straub, 2009). Comparisons of various diffusion models from different fields have found that "a broader view of adoption is necessary for understanding adoption of technology" because "Successful facilitation of adoption is most likely to occur at the intersection of the cognitive, affective, and contextual factors" (Straub, 2009, p. 644).

Other models emphasize teachers' competence and creativity in redesigning learning through technology integration, such as Puentedura's SAMR model (Puentedura, 2014). The SAMR model describes a range of teaching with technology that starts at Substitution and Augmentation levels where the use of technology enhances a more traditional lesson. At the Modification and Redefinition levels, the technology is used to transform the original learning activity to one enabled by the unique features of the specific technology and the teacher's ability to reimagine the students' engagement with learning.

Still other models of teacher learning and implementation progressions involve teachers in examining several factors simultaneously to self-assess as a part of their professional development. Lin, Wang, & Lin (2012) propose a two-dimensional model of

ICT implementation which plots technical practices on one axis and pedagogical practices on the other. The pedagogical competencies ranged from direct teaching to constructivist learning. On the other axis, technical competencies ranged from nonuse to creating multimedia teaching materials. See Figure 1. To validate the model, researchers conducted three case studies of teachers' progression along the model. Analysis of the cases highlighted organizational context factors influencing ICT integration: accessibility of ICT equipment and support, alignment with school curriculum, school climate and culture, teaching load, management routines, and pressure to prepare students for testing. Similarly, Tarling and Ng'ambi (2016) involved practitioners in South Africa to collaboratively identify, analyze and clarify practical problems related to ICT use. Together, they linked ICT integration levels with Bloom's taxonomy of critical thinking skills to develop a Teaching Change Frame. Subsequent self-report data from teachers across resource-deprived rural schools and resource-rich urban schools were analyzed according to the model. The resulting link they discovered between teachers' pedagogical dispositions and their integration of technology can be used in guiding and informing practice. The researchers contrast the method of including and involving practitioners in studying their practice with more traditional implementation processes.

The development of the change process was informed by a "pull" rather than the typical "push" approach: traditionally teachers are pushed toward the change agendas of organizational leaders or systemic policy directives. Creating environments that 'pull' teachers toward change is an alternative. (p. 570)

These two studies of technology integration reflect a growing understanding that teacher perception and practice are constructed through interactions with others, and that

educational technology integration can be a particularly fruitful area for participatory or inquiry-oriented study (Dawson, 2012; Dooley, Ellison, Welch, Allen, & Bauer, 2016; Krumsvik, 2012).

Figure 1. The pedagogy * technology model for information and communications technology integration in education (Lin et al., 2012, p. 100). Copyright Lin, Wang, & Lin, 2010. Reprinted with authors' permission.

Communities of practice support critical interactions. In their multi-case study of three teachers implementing a one-to-one laptop program at an independent school, Windschitl & Sahl found that when learners were open to innovating with technology in their teaching, “one of the most powerful settings is regular planning time with a colleague” where “sense-making opportunities for participants to construct meaning in connection with the use of technology” (p. 202). On the other hand, these settings could

vary widely depending on who joined; “the collective impact of participation in those settings appeared to be dramatically shape by teachers’ situated beliefs about learners and legitimate learning activities in the classroom” (p. 202). Just having collaborative learning opportunities does not necessarily spark innovative practices. Maker’s (2012) quantitative study showed little to no correlation between professional learning community strength and innovative practices.

In the real-life process of learning and implementation, planning and progress can be messier than implied by learning models. While teacher technology implementation progression can be helpful tools for self-assessment and learning, Levin & Wadmany (2008) find that the actual process of constructing new understandings and practices proves less stage-like in progression, and more dependent on the specific contexts of the teachers learning to integrate technology. Their three-year longitudinal study of six upper elementary school teachers’ ICT integration not only “highlight[s] the fact that teachers’ beliefs are shaped by everyday classroom and school experiences” but lead them to question the stage-like structure of innovation adoption models. Instead, Levin & Wadmany (2008) propose that teacher learning followed:

a developmental model that is cyclic or helical, wherein classroom practice and dialogue with others and with new artifacts affect the depth of teachers’ learning, their cognitive views, and feelings, and their behaviors in a wide range of change dimensions. (p. 254)

The various and complex developmental patterns that emerged over three years suggested to the authors that a combination of personal and institutional factors interact as an ecological system affecting how teachers individually construct their knowledge and practices.

While leadership can provide resources and set a vision for technology implementation, teacher beliefs and practices determine whether and how innovation happens. Within the ecological system of the school, critical interactions shape technology innovation through teachers' feelings, experiences and learning.

Conditions needed for technology innovation. The needs of those charged with innovation implementation vary broadly by industry and context. Differing priorities across higher education, business, and K-12 contexts led Ensminger & Surry (2008) to suggest that implementation strategies would need to be tailored to the unique circumstances of the industry or sector. Even within the sector of education, implementation strategies interact with a variety of context-dependent factors.

Zhao et al.'s (2002) year-long study of more than 100 K-12 teachers engaging in technology innovation through a technology grant identifies eleven factors, which they organized into three interactive domains. The model is shown in Figure 2. Here, the authors propose an empirical model to help address the large question of “why don't teachers innovate when they are given computers?”

The question is an important one since ubiquitous technology does not initiate teachers' movement towards constructivist practices (Grimes & Warschauer, 2008). Similarly, in their multi-case study of three teachers implementing a one-to-one laptop program at an independent school, Windschitl & Sahl (2002) found that “the availability of technology was neither a necessary nor a sufficient condition to affect pedagogy—indeed, the fact that all students had their own computers did not compel two of the

participants to use the technology itself to any significant degree in their classrooms” (pp. 201-202)

Figure 2. Conditions for classroom technology innovations show the interplay among the teacher's frame of reference, various elements of the school context, and how far removed the new use of technology is from current practice. (Zhao et al., 2002) Copyright 2002 by Teachers College Record. Reprinted with permission.

To answer this conundrum, Zhao et al. (2002) examine factors that facilitate technology innovation when teachers have taken the initiative to apply for grants to support their plans for innovation. Through a mixed method analysis of surveys, interviews, and observations of 118 projects supported by grants across a variety of sites and locations, 10 case studies were selected to represent the variety of contexts for analysis of significant factors that played a role in the projects' success or failure.

Empirical analysis confirmed the assumption that teachers' technology proficiencies played a key role in teachers' ability to innovate. As the first domain of successful technology implementation, teacher technology proficiencies were delineated into dimensions of technology knowledge (how to manage or fix related technical problems), compatibility between the technology and the teachers' pedagogical beliefs, and the ability to navigate social aspects of the school culture to support their changes in practice.

In addition, the domain of Innovation, or "the project," was defined as the difference between the technology projects teachers aimed to implement and previous practices. These innovation "distances" mattered in terms of school culture (relative to dominant values, pedagogical beliefs and practices of the teachers and administrators), the teacher's existing or prior practice, and distance from available technological resources (such as new technologies required).

The third major domain mediating the success of technological innovations involved the context of the school. Key elements included the human infrastructure (access to technical support from others), technological infrastructure (such as accessibility of devices and connectivity), and social support from collaborative peers. Of the three

domains, the teacher as innovator played the most significant role. The qualities of projects could also significantly influence the outcome, although a strong context could compensate, to some extent, for teacher weaknesses.

Zhao and colleagues' model of conditions for classroom technology innovations "point out serious problems with the current efforts to prepare teachers to use technology. Most of the current efforts take a very narrow view of what teachers need—some technical skills and a good attitude" (p. 511). The authors provide a more detailed look at the complex, interactive factors within a school that contribute to teachers' ability to innovate with technology in the classroom. They conclude that, while individual competencies and skills are important, technology innovation efforts and initiatives hoping to succeed cannot rest solely on training and supporting the individual. Such efforts also need alignment with organizational factors and supports.

In recognition of the context-based factors uncovered by Zhao et al.'s model, Groff and Mouza (2008) developed and integrated the factors into a framework to potentially predict the success of technology-based projects in the classroom called the Individualized Inventory for Integrating Instructional Innovations (or I⁵). Empirical results and new models for gauging readiness for technology innovations are beginning to take into account the variety of context-dependent factors which play a role in facilitating or inhibiting technological innovations at the classroom level, but have yet to be tested in real world contexts (Groff & Mouza, 2008).

Towards a Systems View—Schools as Learning Organizations

Examining classroom technology implementation at the classroom level over time points to a systems view of schools and a change process which reveals the extent that schools function successfully as learning organizations. Other case studies also highlight the important roles that aligned local ecological systems (Staples, Pugach & Himes, 2005) and participatory learning opportunities (Herro, 2015; Windschitl & Sahl, 2002) can play in supporting and sustaining emerging technology innovations in the classroom. Whether following individuals carrying out technology innovation projects or examining successful ICT implementation over longer periods of time, studies of technology innovations point to context-specific conditions that interact with the actors and the instruments of technological change in the classroom.

Based on their sample of teachers who had won grants for innovating with technology from across different school contexts, Zhao and colleagues' (2002) three domains point to the importance of considering the school as a system. The study's domain analysis emphasizes the importance of school context in supporting technology integration in teaching. The authors contend that support of teacher learning should pay attention to pedagogical and curricular connections to technology use as well as the social and organizational aspects of school. They caution, "Given these findings, teachers should take an evolutionary rather than revolutionary approach to change. It is likely that teachers will experience more success and less frustration if they take small, but progressive steps toward change" (Zhao et al., 2002 p. 512). A case study of innovation processes within a single site could capture and describe how actors within an ecological

system manage or contend with balancing the various factors through the process of change in order to pave the way for broader technology integration across the organizational system.

Taking schools rather than teachers as the unit of study, Wong et al. (2008) purposefully sampled and examined 8 cases of successful ICT implementation. The authors' goal was to compare local contexts to find factors that contribute to successful implementation across different regions and different approaches. Through their review of variables impacting ICT implementation, the authors formed a research analysis framework based on relevant contextual factors, focusing on the particular relationship between technological innovations and pedagogical innovations. They focused in on how the contextual factors interacted with one another to impact teaching and learning with ICT. Using the framework, the authors identified two models of successful innovative classroom practices mediated through ICT—a balanced model where innovations were driven both technologically and pedagogically and a second model placing student-centered pedagogical innovations as the drivers of ICT implementation. The first model illustrates the mutual influences within a school context, namely how leadership and school climate influence pedagogical beliefs and practices and ultimately ICT innovations in teaching and learning. The framework for this model is shown in Figure 3. Student-centered pedagogical innovations were critical factors that determined whether ICT was used to transform classroom practices towards constructivist uses of technology—the types of use that hold the potential for bridging the digital use divide.

Figure 3. The emergence of ICT implementation strategies at school and classroom levels show that ICT-Pedagogical innovations are informed by both the roles of the technological innovations and prevailing pedagogical beliefs and innovations (Wong et al., 2008, p. 3).

To illustrate this concept, in schools where ICT implementation was purely technologically driven, ICT “mainly acts as a visual tool to make learning a more interesting and focused experience” (Wong et al., 2008, p. 257). Without the pedagogical practices that put students at the center using technology, ICT implementation was “uncoupled” from pedagogical development, and technology was used for passive consumption—the type of use that sustains the digital use divide. Wong et al.’s framework focused on the school organization as the unit of study and attempted to add arrows of directionality and influence within the organization. Notably, such directionality and influence helped to uncover missing factors that could leverage ICT to facilitate students’ active construction of new understandings.

Wong et al.'s framework overlaps with some of the implementation lessons introduced through this review of literature. Specifically, leadership, school climate, teacher pedagogical practices, and technical innovations have all emerged as important factors that interact with each other within the ecological system of the school to influence how technology is ultimately integrated into teaching.

An integrated model of ICT innovation in a school learning system. Zhao and colleague's (2002) concept of the factors and domains affecting classroom ICT innovation includes specific aspects about the Teacher, the Context, and the Innovation that affects the success of teachers' innovations. Their findings highlight teachers' ability to navigate the human and technological infrastructure of the school to support them through the unknowns of new practices when they have taken the initiative to plan and implement them with an outside grant. Meanwhile, Wong et al.'s (2008) model focuses on school contexts and adds directionality between leadership and climate, and again between climate and teachers' pedagogical beliefs and practices. This model begins to examine leverage points for fostering innovative practices, and the comparative impacts of different drivers of change. This review of technology implementation literature highlights the importance of supporting students' active use and learning with technologies through active engagement of teachers' learning within the context of the school. Within the organizational context, alignment of resources, communities of practice, and cultural conditions to support innovation all matter in creating a fertile ground for innovative practices to germinate and grow. A framework integrating these key factors could be used to examine how a school learning community facilitates

technology innovation to address the digital use divide. Within the ecological system of the school, what are promising practices for a learning community to facilitate technology innovation? What might impede a learning community's ability to facilitate technology innovation? An integrated framework for analysis takes Zhao et al.'s and Wong et al.'s models of conditions for ICT innovation as well as key factors such as leadership and school climate into a model of the organizational system, with its directional influences. Figure 4 illustrates the school as a complex system of interconnected domains with elements highlighted by technology integration research.

Figure 4. An integrated framework of Technology Innovation factors in a school as a learning organization and the potential role of PLCs as a structure for facilitating ICT-pedagogical innovations

Professional Learning Community (PLC) as a leverage point in the system.

Within this systems model of a school's capacity to support technology integration, a

professional learning community may provide a potential leverage point for adding, changing or evolving the larger system within the organization. Professional Learning Communities, or PLCs have been seen as a pathway towards the “self-organization” as described by Meadows and Wright (2008), widely known for their work on systems thinking. Meadows & Wright (2008) describe self-organization as the ability of a system to evolve from a diversity of human behavior, culture and creativity; they also list self-organization as one of the most powerful leverage points of change within a system (p.159).

As research on technology implementation has shown, experimentation leading to sustainable practice happens when aligned with the organization’s values (linked to its culture) and goals (linked to its vision). A learning organization evolves by adjusting these values and goals. According to Vickers’ classic study of management and decision-making (first published in 1965 and republished in 1995), changes in dynamic systems require an “appreciative” process of regulation that involves making value judgments on the “state of the system” based on some standards for evaluation, which then leads to some response. The standards reflect core values of the system by setting shared goals and in turn provide a vehicle to drive change within that system.

Associations across the organization affect internal alignment and progress towards the system’s goals. Vickers’ (1965/1995) description of policy-making and management as an art of making value judgments aligns with modern views that learning organizations such as schools are driven by their functions or purposes (Meadows, 2008; Senge, 2012). In a systems view of schools, changes in a school’s interconnections and purposes have

the potential to most dramatically change the system itself. Senge et al. (2012) compare this systems view of schools to living systems that are “always evolving” and emphasizes that systems’ “need to have the capacity as communities to prioritize new thinking and new practice and to persist in supporting it” (p. 69). This persistent support is critical because, in a human-ecological system, all affected are “involved as *agents*, concerned directly or indirectly in forming or frustrating policy” (Vickers, 1995, p. 253). A learning organization must set a direction, align values, and involve a wide range of actors for change to happen and to persist.

In interconnected systems, organizational change rests largely on evolving value judgments—setting new goals in alignment with developing core values. The power of an innovation’s reach within the organization involves “some preexisting set of readiness to see and value the situation in one way rather than another” (Vickers, 1995, p. 63). If the ability to self-organize starts with determining goals to guide subsequent actions, a Professional Learning Community may function as a microcosm of the whole, translating values and goals into beliefs and practices through its ongoing collaboration and reflective practice between members of the group. Such a PLC may evolve into a steering mechanism for the organization, shaping organizational goals through its practice and associations with the rest of the system. In this manner, PLCs have been linked to building organizational capacity and distributed leadership (Spillane et al., 2001; Stoll et al., 2006; Vescio, Ross, & Adams, 2008).

Distributed leadership: Definitions, relationship to PLCs. Distributed leadership has been described in the literature as sharing or dividing leadership tasks (Robinson,

2008; Spillane et al., 2001) and sharing influence or power (Gronn, 2008). The degree of distribution of such influences can occur on a continuum, which is dependent on organizational context as well as a leader's individual inclination (Spillane, Harris, Jones, & Mertz, 2015). Furthermore, the locus of power and influence may also evolve with fluidity, changing with the nature and needs of the task at hand or with the specific tools of leadership in development or in use with varying effects on organizational performance (Harris, 2008; Gronn, 2008).

While Spillane and Healey (2010) call for researchers to better operationalize distributed leadership theory to specific definitions and measures, Robinson (2008) adds that previous studies emphasizing distribution and frequency measurements of leadership tasks rather than results have fallen short of linking leadership practices to student outcomes. "One implication of not studying the consequences of various influence practices is that little is learned about the change process that is at the heart of leadership" (Robinson, 2008, p. 246). Noting that "empirical research on the role of tools in distributed leadership practice is in its infancy" (p. 250), Robinson argues a need to examine leadership practices for effectiveness even before asking how the tools and tasks support distributing leadership.

For example, in a meta-analysis of 16 empirical studies mapping leadership practices to student gains through teacher learning, Robinson and Timperley (2007) reviewed and examined studies of teacher professional development that led to improved student learning outcomes. The authors synthesized impactful aspects of leadership, identifying five broad dimensions. These dimensions included providing educational direction

through setting explicit goals: ensuring strategy alignment with students' learning strengths: creating a learning community focused on improving student learning outcomes: engaging in constructive inquiry into problems of practice: and selecting and developing "smart tools" which incorporate standards of good practice and routines to support the wise use of the tools (Robinson & Timperley, 2007, p. 256). In addition to these high leverage leadership actions, Robinson points out that, at the level of focus needed to impact student learning, leadership practices would necessarily be tied to some sort of educational content (Robinson, 2008, p. 255).

Such a shift towards outcomes-based leadership practices that share or distribute important tasks or influence would point to "a critical research agenda" involving "the study of the conditions under which teachers, especially those without positional authority, succeed in influencing their colleagues in ways that benefit students" (Robinson, 2008, p. 254). Robinson notes that such descriptive research would involve studying how leadership is "distributed in particular contexts and the antecedents and consequences of such distribution" (p. 251). A PLC focused on supporting site implementation of students' productive use of technology could answer important research questions about patterns of influence based on task relevant expertise, sources of in-school influence on teachers' practices, and how tools might help to facilitate school change (Robinson, 2008, p. 251). At the intersection of teacher learning and school change, a professional learning community holds potential for building distributed leadership capacity to attend to relevant factors within their shared context.

When part of a system of distributed leadership, an effective PLC helps to enact the shared vision of teaching and learning practices (Spillane, Halverson, & Diamond, 1999). Within an effective PLC, members collaboratively problem solve and reinvent practices to make progress towards the shared vision (Stoll et al., 2006; Stoll & Louis, 2007). Participants gauge and share the challenges and successes of their own practices through cycles of learning in supportive environments (Giles & Hargreaves, 2006; Vescio et al., 2008). Over time, such well-functioning teams can gather and align resources and supports for the broader school community, branching its relationships out beyond the original group and into the larger school community (Chrispeels, Castillo, & Brown, 2000).

Early definitions of PLCs relate to communities of practice. What, exactly is a Professional Learning Community? Even as researchers and practitioners generally agree that effective professional learning communities have the capacity to promote staff and student learning in schools (DuFour, 2007; Hargreaves, 2007; Little, 2012; Stoll & Louis, 2007), definitions have varied in emphasis over the more than two decades-long of discussion about them.

There is no universal definition of a professional learning community, but there is a consensus that you will know one that exists when you can see a group of teachers sharing and critically interrogating their practice in an ongoing, reflective, collaborative, inclusive, learning-oriented, growth-promoting way. (Stoll & Louis, 2007, p. 2)

At their origins, professional learning communities described voluntary processes involving members who wanted to improve practice (Hargreaves, 2007). This definition paralleled communities of practice from the business sector, which emphasized a systems

view of problem solving and adaptation (Wenger, 1998). Wenger explained that communities of practice support adaptive “learning organizations” through the groups’ ability to self-organize around problems, renew learning through participants’ interactions, and develop participants’ professional identities. In describing the on-going nature of these communities’ learning, Wenger emphasized how “radically new insights often arise at the boundary between communities” to challenge and spur learning at its core. “Communities of practice truly become organizational assets when their core and their boundaries are active in complementary ways” (Wenger, 1998, p. 6). At their core, PLCs are built on “1. Professional learning; 2. within the context of a cohesive group; 3. that focuses on collective knowledge, and 4. occurs within an ethic of interpersonal caring that permeates the life of teachers, students and school leaders” (Stoll & Louis, 2007 p. 3).

PLCs as a vehicle for reform. The idea of professional learning community gained broad political support (Hargreaves, 2007) and brought “burgeoning interest demonstrated by school districts in promoting ‘professional learning communities’ at the school and district levels” (Horn & Little, 2010, p. 183). This context of urgent and widespread interest challenged practitioners who were tasked to implement PLCs as structures for reform. While evidence supported PLC practices as “our best hope for sustained, substantive school improvement” (DuFour, 2007), “too few schools [knew] how to start—or, if they [were] already well along the road to developing professional learning communities, how to inject further energy into their efforts” (Stoll & Louis, 2007). It is important to note that the concept and discussion of PLCs began at a time

when “tensions in the arena of school reform” were growing “formidable” (Louis & Marks, 1998, p. 561). This political backdrop would prove to be an important part of the broader implementation context.

In their study of teacher professional communities, Louis and Marks (1998) examined the positive impact of such communities on student learning across 24 nationally selected elementary, middle and high schools. Their findings highlighted students’ high levels of academic performance and suggested that the teacher professional communities contributed positively to the teaching practices and cultures of the schools. In recognizing the political landscape of the time, the authors surfaced three competing areas of tension—the political push for systemic reform, calls for decentralizing control of schools, and colleges of education reexamining the role of individual teachers as professional decision makers. Cautioning that “these debates will not be resolved by a study of 24 restructuring schools,” Louis and Marks emphasized the importance of developing school-workplace relationships of trust and genuine collaboration as opposed to “contrived collaboration” that happens “when standardized efforts to promote community are imposed on the school from without” (p. 561). Their warning proved to be a harbinger of times to come.

In a later study of the impact of standards-based reform on the sustainability of innovative schools’ over time, Giles & Hargreaves (2006) found that standards-based reforms led to external mandates that ate away at the structures and schools that had been held up as model learning communities in the first place. For example,

...although the school was featured in the Ministry’s promotional videos for reform, the standardized nature of external mandates recycled Blue

Mountain's innovative ideas back into the school in ways that diminished and sometimes made unimplementable the very initiatives the Ministry "borrowed" from the school in the first instance. (p. 145)

Giles and Hargreaves conclude by noting the paradox between calls for professional learning communities at the same time that narrow, standardized measures of achievement were "micromanaging the process of learning to such a degree that there is little scope for teachers to learn in what little time is left over" (p. 153). Hargreaves would later (2007) observe that in such a standards-based reform era, "PLCs are turning into add-on teams that are driven by data in cultures of fear that demand instant results" (Hargreaves, 2007, p. 183). He also warned that such a "tunnel-vision focus on manipulating and improving test scores in literacy and mathematics by any quick fix available" would be more likely to drive PLCs in poorer districts compared with "more affluent communities where schools meet measured standards and enjoy the freedom to explore beyond them" (p. 189).

Reform proponents suggested that mixed results of PLCs as reform structures came from misunderstandings about what was crucial because "...the term has been used so ubiquitously that it is in danger of losing all meaning" (DuFour, 2004, p.6). What both sides agreed on was that the type of collaboration characteristic of effective learning communities was easier identified than created or sustained. They also overlapped in describing effective PLCs as characterized by a transparency of practice and openness to change that required building trust and practices over time, with support from leaders, especially in an era of high stakes teacher accountability (DuFour & Mattos, 2013; Giles & Hargreaves, 2006; Halverson, 2007; Nelson & Slavit, 2008; Servage, 2008).

Moving towards a framework for an effective technology PLC. Given the range of views about what PLCs are, the debates about their role through standards-based reform, and their potential for fostering organizational learning, it becomes even more important to define critical elements and practices. PLCs are not a recipe-driven process (DuFour, 2007), nor should they focus solely on narrow test scores (Hargreaves, 2007). Yet “if we are to theorize about the significance of professional community, we must be able to demonstrate how communities achieve their effects” (Little, 2002, p. 937).

Current attempts to link PLCs to technology implementation fall short in identifying key elements and describing teacher interactions within the organizational context.

Maker’s (2012) study of the relationship between PLCs and K-12 teachers’ implementation of technology highlight the importance of both these criteria. The study results showed little to low correlation between PLCs and technology implementation, concluding that technology implementation had more to do with level of teaching (elementary and middle school teachers showed more innovative practices than high school teachers) and teachers’ pedagogical values. The research design relied on quantitative analysis of survey data across a number of school sites in one district in Northwest Florida. This methodology did not allow for analysis or understanding of the interactions fostered by PLCs—to determine whether collaboration is “genuine” or “contrived” (Louis and Marks, 1998)—much less describe the important school-level contextual factors that may have facilitated technology innovation in the classroom.

The framework for considering PLCs for this study includes three critical functions, drawn from a review of literature on effective professional learning communities, which

build practices within PLCs and potentially into the larger school organization. Based on key features of effective PLCs, this framework provides a guide to focus analysis for in-depth exploration of not just whether there is a link between PLCs and specific technology innovations, but how aspects of PLCs and school contexts interact in the process. The three critical functions of effective PLCs include: 1) keeping the collective focus on teaching for learning, 2) facilitating collaborative problem-solving to reinvent practices, and 3) building capacity through expanded roles and relationships of participants.

Collective focus on student learning. Effective learning communities keep the collective focus on teaching for learning. This collectively shared focus on instructional impact may include shared values and vision (Stoll et al., 2006), the use of data to gauge the effects of teaching strategies towards learning goals (Chrispeels et al., 2000; DuFour, 2007), and determining underlying values and ideals for pedagogy and practice (Servage, 2008) in order to build leadership capacity to enact instructional innovations (Spillane et al., 1999). Hord (1997) describes schools with strong organizational capacity as those with well-defined missions that includes goals for student mastery and improvement. Spillane's (2001) description of distributed leadership centers on instructional practice and emphasizes, "It is necessary to ground our efforts in a framework for examining instruction" which is best understood as "constituted in the interaction of the teacher, students and material" (Spillane, 2001, p. 26). According to DuFour (2004) effective PLCs focus their collective efforts on critical questions to gauge the "attained curriculum" compared with the "intended curriculum" (p. 4). DuFour details critical

questions to guide PLCs. These questions zero in on identifying the goals for learning and finding ways to monitor the impact of instruction on student learning. Using information to engage in reflection on how instructional practices affect learning serves as a critical foundation for professional learning communities.

Collaborate and problem-solve to reinvent practices. A group's ability to collaborate depends on group dynamics, individual orientations to change, and constructed rituals and behaviors for working together (Servage, 2008; Stoll et al., 2006). While these factors are dynamic and highly variable, they impact a PLC's ability to collaborate effectively. In order to become a learning community, PLCs must go beyond merely exchanging practices (Senge, 2012), or "pooling opinions" (DuFour, 2007) but engage in collective learning and collaboration to reinvent practices together (Little, 2002; Stoll, 2006), or team problem solving (Crispeels et al., 2000). The ability to problem solve to reinvent practices is what makes a PLC's capacity surpass the sum of its parts and defines how effective the group can become.

Collaboration and problem-solving are keys to collective learning, distributed leadership, and defining a learning community (Stoll et al., 2006). The cooperation involved in "deep learning cycles" characterizes Senge's (2012) learning organizations and illustrate Hord's (1997) description of interdependence as a key factor of professional learning communities.

Yet in practice, teachers participating in communities of practice such as PLCs often encounter both dilemmas and opportunities when differences arise. Whether or not teachers are able to construct new understandings can vary widely for a host of reasons.

Judith Warren Little (2002) recognized that “relatively little research examines the specific interactions and dynamics by which professional community constitutes a resource for teacher learning and innovations in teaching practice” (p. 918). Her analysis of teacher interactions in the midst of such collaboration and planning led her to develop a conceptual scheme of teachers’ potential “trajectories of development” in communities of practice based on three “central concerns” she calls “representation of practice, orientation to practice, and norms of interaction” (p. 934).

Representation of practice refers to the aspects and ways in which teachers speak of their practice, and how transparently teachers feel comfortable talking about their teaching and their thinking about their teaching. Teachers’ transparency about their practice—from the topics they take up in conversation, to material artifacts they share, to lesson demonstrations, review of student work, or curricular planning—can open or close further dialogue. Representation of practice can be affected by the interdependence of teachers’ work and how deeply the group shares standards of “good teaching”.

Orientation to practice refers to teachers’ stances toward changes in practice and improvement; in other words, what is the central purpose of the learning community? This is important because, as Little reminds us, “communities of practice should not be romanticized; they can reproduce counter-productive patterns...and abuses of all kinds” (Wenger, 1998 as cited by Little, 2002 p. 935). In a separate paper reviewing studies of effective professional development and collaborative professional communities in learning-centered schools, Little (2012) acknowledges that while staff cooperation itself may be unrelated to student achievement, collective responsibility for student learning

was linked to significantly higher achievement (Little, 2012, p. 17). The skill and will to engage in disagreement in order to move towards aligning understandings for the sake of collectively supporting student learning is a critical aspect of moving away from a culture of privacy toward an effective teacher learning community (Horn & Little, 2010).

Finally norms of interaction concerning how language is used and how participation and interaction are organized affect teachers' learning or changes in practice (Horn & Little, 2010; Little, 2002). Horn and Little (2010) suggest that analysis of these interactive patterns, or "conversational routines," can reveal aspects of talk and participation that open up or close off inquiry into practice (Horn & Little, 2010, p. 184). "It is in the ongoing activity, and through manifest changes in action, participation, and knowledge in use, that learning becomes apparent" in teachers' professional communities. (Little, 2002, p. 937).

Together, the research of Little (2002, 2006) and Horn and Little (2010) point to three critical aspects of moving from professional learning community in name towards teacher learning communities that influence each other's thinking and practices: how transparently teachers choose to represent their practices, their will and skill to engage and explore each others' practices through potential disagreements or differences in perspective, and ultimately, their openness to each others' ideas and acceptance of the group's initiatives. A PLC's ability to can genuinely collaborate, learn, and grow new practices, while at the heart of its effectiveness, may also be one of the most challenging factors to capture and analyze.

Build site capacity for distributing leadership. The interdependence involved in problem solving and planning among PLCs also characterizes a leadership group's efforts towards its vision of teaching and learning across the larger organization (Marzano, Waters, & McNulty, 2005). Effective PLC teams problem solve and reflect. When teams become adept at working together, they can leverage members' individual knowledge and skills to co-construct leadership practices through day-to-day tasks (Spillane, 2001). If aligned with other context and leadership factors, PLC teams can become linked to a process of school development through distributed leadership, extending the PLC's ability to leverage self-organization beyond its members into the wider organizational ecosystem.

Spillane (2001) breaks distributed leadership down from a shared macro vision into micro tasks for enacting the vision, defining leadership activity at the level of the school rather than the individual leader. According to this lens of distributed leadership, a PLC may help to develop and focus day-to-day practices such as the use of tools, organizational structures, and artifacts to align the value judgments among an expanding community of actors within the organization (Chrispeels et al., 2000). As PLC teams' collaborative actions and capacities grow, members may expand their roles and relationships within the larger community to share in leadership roles and to affect the broader ecosystem of the school.

Such ecosystems are both impacted by and impact effective PLCs. Chrispeels et al.'s (2000) study of site based management teams found that while school size and demographics did not impact leadership team function, the ability teams had to engage

with the rest of the staff as well as with district level supports helped to define well-functioning teams. These teams were better positioned to build broader capacity and impact on teaching practices and student learning. Just as Wenger (1998) highlighted outside interaction as a strength of communities of practice, school-based professional learning communities also benefit from continuous interactions at their “boundaries.” Bolam, McMahon, Stoll, Thomas, Wallace, Greenwood, and Smith (2005) highlight external facilitators and inhibitors as a factor in effective school PLCs. Similarly, Vescio, Ross and Adams, in their (2008) review of research on the impact of professional learning communities on teaching practice and student learning caution,

...learning communities...cannot be insular, focused only on making explicit the practical wisdom teachers already possess about teaching. Instead learning communities should support teachers in making decisions based on their contexts, their goals, current and new professional knowledge, and the needs of their students. (p. 89)

Vescio and colleagues provide evidence of the essential characteristics of PLCs: 1) shared values and norms, 2) clear and consistent focus on student learning, 3) reflective dialogue about curriculum, 4) instruction and student learning, 5) de-privatization of practice, and 6) focus on collaboration within and beyond the PLC.

The literature on Professional Learning Communities includes broad discussions, rich findings, as well as unanswered questions about what makes some PLCs more effective than others. The framework offered in this chapter simplifies essential components of effective PLC practices into three major themes found throughout the literature: 1) a shared focus on improving teaching practice for student learning, 2) collaborative processes that support reflection and change in practices, and 3) the potential to build

participants' capacity to help build their own, or even to lead others to, more effective practices. Linking these PLC practices to organizational factors that support technology integration may uncover pathways between professional learning communities and sustainable change within the school's technology innovation ecosystem. Studying a site's teacher leaders undertaking innovating practices through a technology PLC *in situ* may shed light on whether and how a PLC may impact teacher beliefs and practices, how it might limit or challenge teachers to innovate, and how organizational factors might impact the learning process facilitated by the PLC.

Summary

Integrating technology into teaching for learning holds the promise of engaging and supporting students' learning in unprecedented ways. Technology holds the potential of fostering critical thinking, collaboration, creativity and communication: skills at the heart of the new standards for the 21st century. Yet getting technology into classrooms, and into the lives of teachers and children, has been a long and challenging process. Meanwhile, teaching with technology in ways that reach its potential for bridging learning opportunities has been even more challenging.

Most recently, the digital use divide highlights the remaining distance between the promise and practice of technology use in classrooms, particularly for the nation's most vulnerable populations of students. It takes more training and effort to teach students to use technology to critique and create digital media. As a result, the default—even when technology is readily available—involves students as passive consumers when technology is used to augment traditional teaching practices. In such cases, technology

serves to either add audio and visual support or to provide extra digital practice on rote skills. Important differences in student technology use can be identified by the varying degree of student agency when using technology and by the degree of critical thinking, collaboration, creativity, and communication involved. In response to the evolving digital use divide, the United States Department of Education has recently adjusted its policies and national educational technology plan (NETP, 2016) to focus on bridging the digital use divide as a national goal for technology integration into schools.

Over more than three decades, studies of technology implementation have led to more complex understandings about the conditions needed to support sustainable innovations of technology integration. These studies have discovered much from the bright spots of practice: from analyzing changes in teacher technology use through long term learning and support: from following technology grant winners through the implementation of their innovative technology practices: from examining driving factors in schools where ICT has been successfully integrated with student-centered pedagogies: and from describing the evolution of practice over one to several years of one-to-one initiatives in schools serving high and low socio-economic populations. Findings from these studies have zeroed in on a variety of school-based contextual factors that enable and support innovative technology integration at the classroom level.

The most critical factors impacting the success and sustainability of technology integration fall in three domains. The first domain has to do with the teacher and includes factors such as the teacher's knowledge of technology, pedagogical compatibility with innovative (versus traditional) uses of technology, and navigation of social networks

within the school to support innovation. The second domain has to do with the technology innovations or projects—whether the resources and networks are available to support implementation, how difficult that innovation may be for the teacher within the school context, and the likelihood that technical problems can be overcome if encountered. The third domain has to do with the school context and includes factors such as the technological infrastructure, the human infrastructure, and the organizational culture in support of the teaching and technological practices involved in the innovation. These factors and domains were empirically constructed and vary by organization, but have not yet been used to analyze specific contexts or cases.

Meanwhile, access to learning communities—both on campus and beyond—varies by context as well and is important in supporting technology implementation. Case studies on technology implementation have identified communities of practice as important leverage points for initiating and sustaining innovative uses of technology. Along similar lines, professional learning communities are well-studied communities of practice and “consistently cited...as our best hope for sustained, substantive school improvement” (DuFour, 2007, p. 3). A review of research on elements of effective professional learning communities (PLCs) identify three critical functions: 1) keeping the collective focus on teaching for learning, 2) facilitating collaborative problem-solving to reinvent practices, and 3) building capacity through expanded roles and relationships of participants.

By and large, case studies of technology implementation have either been comparative case studies for the purpose of identifying supportive factors across contexts or they have been case studies of teacher development focusing on individual changes in

practice. Given the growing recognition that school context factors play important roles in supporting and sustaining technology innovation, given the new urgency of bridging the digital use divide, and given the evidence supporting professional learning communities as an avenue of change, a current review of the literature leads to a new, integrated model of the factors impacting technological innovations as depicted on p. 51 in Figure 4 “School Context for Technology Innovation.” This model may support case analysis of a school at the nexus of broad-based technology innovation.

Such analysis holds the potential to shed light on questions about how educators might participate in a PLC to address the evolving challenges of bridging the digital use divide; how might a technology professional learning community (PLC) affect teacher beliefs and practices related to addressing the digital divide? What aspects of a tech PLC might limit or challenge teachers to innovate related to addressing the digital use divide? Furthermore, what organizational and contextual factors might impact these processes and how?

A new case study examining a professional learning community focused on implementing technology to bridge the digital use divide can provide insights into how complex processes, interactions, and decisions made within a school learning community impacts teacher beliefs and practices with regards to focused integration of technology into teaching. A study to explore context-specific interactions and developments through technology integration may shed light onto pathways of technology innovation, which have proven elusive for so long.

Chapter Three

Methodology

Introduction

Professional Learning Communities (PLCs) hold promise as structures for developing learning organizations capable of evolving with changing needs, mandates, and contexts of school communities. Through the standards and accountability context initiated by the *No Child Left Behind* (NCLB) Act passed in 2001, PLCs grew in popularity as a school improvement structure used to implement data-driven reforms and practices for improving student achievement.

Meanwhile, schools are pressed to integrate technology into teaching for new standards and their Internet-based assessments. With technology implementation studies pointing to key organizational factors that impact classroom use, a link between PLCs and technology integration is emerging, though details about how the two intersect remain unclear. Maker's (2012) study of the relationship between PLCs and K-12 teachers' implementation of technology highlights the importance of defining critical aspects of PLCs and points to a need for methodology to allow for better understanding of the role that PLCs play in influencing technology innovation within specific school contexts. The present study provided a window onto such interactions. It was set in the context of a 1-to-1 ICT device program aiming to address the digital use divide, a key focus of the most recent update of the National Education Technology Plan (2016).

Describing the dynamics of a PLC focused on technology integration and understanding real and potential associations with teachers' beliefs and practices in

addressing the digital use divide offers a window onto change while it is happening. Focusing on site-level development through this common structure also allows an opportunity to consider how factors such as infrastructure, policies, and supports interact with the human and organizational patterns that are part of a professional learning community, and how the interactions affect organizational learning.

Statement of the Problem

The digital divide is a concept that has evolved through the course of technology implementation in the United States. The digital divide describes the net differences in technology access and use across populations of students and communities in the nation. More recently, this construct focuses on national educational goals for technology *use* in addition to access in schools, highlighting gaps between updated goals compared with the range of existing classroom practices. By emphasizing the importance of planning and preparing for change in an equitable and rigorous manner for all, the digital *use* divide exposes some of the challenging, context-dependent aspects of meeting 21st century demands in our nation's schools.

In 2016, the National Educational Technology Plan (NETP) was updated to reflect new understandings of the gaps between our nation's most current technology integration efforts and the goal of providing all students with a 21st century education. Recent data points to considerable progress in providing access to hardware and Internet connections in the growing number of places; technology is growing in abundance and becoming more readily available. Yet the updated standards now define and highlight a new digital use divide, characterized by differences in pedagogical practices related to technology

integration. This newly identified divide differentiates between technology *implementation* characterized by passive digital content consumption and technology *innovation* resulting in students' active production of content. However, such productive use of technology, and the development of new digital literacy skills, is more likely to be experienced by students from higher socio-economic classes (Dolan, 2016; Lee, 2014). In this context, providing students with equitable access to pedagogical practices supporting active technology use defined by student voice, choice, and agency have emerged as the new focal point of the 2016 National Educational Technology.

Since federal, state and local policies first aimed to spur technology use in schools more than thirty years ago, implementation efforts and studies have led to deeper understandings of the complex factors affecting such innovations, leading researchers to focus in on the organizational level of change. More recently, studies have led to theoretical frameworks about school-level factors affecting technology implementation and innovation. Case studies using survey research have tended to focus on teachers' technology implementation experiences across a range of school contexts rather than within shared networks and organizations.

Even as frameworks and readiness tools recognize that administrators and teachers are the ones carrying out implementation initiatives, often without much preparation or training, few studies hone in on the processes involved in integrating technology mandates into visions guiding practice. Once resources are in place, school practitioners ultimately carry the torch and shoulder the burdens of realizing the nation's aspirations and goals for technology use through their daily decisions—planning, pedagogy, and

practice. It is therefore critical to better grasp how teacher practitioners and school leaders might construct their understandings around technology use to shape and direct supports for technology innovations within their organizational contexts.

Within an organization, Professional Learning Communities, or PLCs, have been defined as communities of practice in which educators take collective responsibility for student learning, and interact in ways that inform and develop more effective practices (Horn & Little, 2010; Louis & Marks, 1998; Servage, 2008), sometimes distributing leadership roles in the process (Harris, 2008; Robinson, 2008). Even as standards-based reform initiatives have spurred some debate about the most critical aspects of PLCs (Hargreaves, 2007), a review of PLC effectiveness (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006) concludes that “building PLCs is by no means easy” (p. 247), yet they “appear to hold considerable promise for capacity building for sustainable improvement” (p. 221). Horn and Little (2010) attempt to better understand how improvements are realized by analyzing and comparing various teacher interactions within the contexts of teacher learning communities. In so doing, they identify multiple layers of influence that help to determine the extent that teacher interactions hone in on problems of practice to deepen teacher pedagogical understandings.

Technology implementation research points to the need for schools to develop new technology skills in conjunction with student-centered pedagogical practices. Thus, the types of ICT integration are dependent on the school context and capacity to support technology learning and innovation. For these reasons, studying the processes and interactions of a tech PLC can provide new insights on the potential impact that the

familiar structure of a PLC might have on developing and supporting effective technology integration in for 21st century learning.

Purpose of the Study

Given that the thirty-year experiment of technology implementation has led to a focus on the school and non-material context factors largely contributing to an emerging digital use divide, how can schools support important understandings and practices to leverage the technology they have recently acquired? The purpose of this study is to examine and describe ways in which a PLC contributes to developing teaching practices aimed at addressing the digital use divide. It does so within the context of a school with a one-to-one digital device program serving a student population where more than 60% qualify for free and reduced lunch. From this environment of available technology resources, a student population that is vulnerable to the digital use divide, and a staff that regularly uses Professional Learning Communities to support learning in the content areas, this case study examines teacher participation and processes involved in a new PLC specifically organized around technology implementation as the school aims to develop a technology-focused program of choice within the school district. It aims to answer the following questions.

1. How is participation in a technology PLC associated with teacher beliefs and practices related to addressing the digital use divide?
2. What are the aspects of the PLC that facilitate teachers' innovative practices related to addressing the digital use divide?
3. What are the interactions between school-based context factors and teacher

collaboration and learning in the PLC?

Examining a technology-PLC's process through these lenses may point to potential avenues for enhancing a school's capacity to innovate in the current time of change.

Research Design and Procedures

This descriptive case study involves elementary teachers at a public school in a California suburb of the San Francisco bay area. The school serves a diverse population reflective of the state, including about 64% who qualify for free and reduced lunch. Located in a relatively affluent area of the Silicon Valley, the mid-sized school district recently passed community bond measures that have supported substantial investments in facilities and technology upgraded. The school at the center of this study completed extensive modernization of its facilities and a three-year ramp up to one-to-one digital devices in grades 3-5 and providing one i-pad for every two students in grades K-1 the year before the study took place. Using a combination of survey data, interviews, and observations, this study builds on accumulating research and a small pilot study, which I conducted at the site in the spring of 2015 while the site was in the midst of building up to the one-to one digital device ratio mandated by the district.

That initial study pointed to teacher technical skills and pedagogical practices needed in order to pave a pathway to innovating with technology in the classroom. The pilot study of two early-adopter classrooms using Google apps found that teachers were challenged to find time to identify and learn how to integrate high-leverage applications, which could be used in a variety of ways for both teaching and learning, by teachers and students, across content areas. The teachers who built up their technology skills to

integrate these high-leverage apps faced additional challenges of facilitating and monitoring students' on-task, responsible use of the apps. Because high-leverage apps allow for digital collaboration, they also challenged teachers to structure and support communication that is not as easily monitored as traditional modes of communication and collaboration. Freedom of access, responsible use, and methods of monitoring and supporting responsible use needed to be puzzled out by teachers integrating them for the first time. Promising practices for supporting teachers pointed to aligning the culture and expectations of the school to support responsible and productive uses of technology for communication. Since the pilot study, the school developed a tech leadership team to help inform site technology goals, expenditures, and professional development supports.

The current study revisits the site and describes how a technology specific PLC functions to support teachers in defining core practices in the midst of a critical moment; the school is in the midst of sharing its technology-focused vision with the community as a new "program of choice" in the school district. A key part of the school's vision includes taking a school-wide cumulative approach to addressing the digital use divide. Leading up to the study, an informal steering committee in the school has expressed interest in spending time to develop tools to support practices that will define the school's evolving program and identity.

This case study zeros in on this teacher collaboration process to describe and better understand how a technology PLC, located within a school and focused on integrating technology to bridge the digital divide, affects teachers' beliefs and practices. This mixed

methods study includes analysis of survey results to examine pre-post differences in teacher technology skills and classroom uses of technology.

As the principal of the school and researcher of this study, I kept a reflective journal, took PLC observations notes, and transcribed audio recordings of meetings and individual interviews for analysis based on an effective PLC framework and technology innovation factors framework, with a focus on emerging connections between the goals set by the tech PLC and patterns of interactions among group members towards those goals. Three mini-cases of PLC participants were selected to illustrate specific perspectives of the purpose and experience of the technology PLC. Figure 5 provides a visual overview of the research design of this study.

Research methodology and theoretical framework. This descriptive case study focused on technology integration through a technology professional learning community. It was grounded in qualitative methods based on a social constructivist and pragmatic stance. The purpose of this study reflected my experience as the administrator of this Title 1 school in an age of accountability, school choice and change. Such public schools serve vulnerable populations, having done so under the scrutiny and sanctions of *No Child Left Behind* while also learning to build public relations in a growing era of choice. Meanwhile changing standards, along with new local and national initiatives have immersed all schools in swift tides of change. This work was driven by the belief that public schools should “benefit those who are marginalized in society” (Bogdan & Biklen, 1998 as cited in Theoharis, 2007 p. 224) and that research aims to describe new

understandings that are meaningful to researchers as well as to the community under study (Stake,1997).

Figure 5. Overview of research design illustrating the interplay between the site context, data collection, and analytical framework.

From a broad perspective, the core framework of this study recognized that individuals' understanding of the world in which they live and work is constructed through participants' views and interactions. Recognizing the importance of such interactions, teacher study groups, teacher inquiry groups and professional learning communities are structures aimed at building practices which can lead to site-based management teams that re-culture organizations into learning organizations (Marzano et

al., 2005; Senge, 2012). They can also be structured to focus specifically on addressing equity issues (Herr & Anderson, 2015). A school—with its many day-to-day interactions between students, teachers, staff, and community members—reflects a complex, evolving environment where subjective meanings are negotiated through interactions with others. The organization's social, cultural, and historical contexts inform the interactions, shaping but not determining them (Creswell 2013; Charmaz 2014). As the school community interacted with technology and with each other, views of its implementation no doubt influenced as well as were influenced by interactions with others experiencing the changes within the shared organizational context.

This study describes a group's pragmatic focus on moving from information gathering to determining actions to shape the organization's progress towards integrating technology in equitable ways. For these practitioners, truth was defined primarily by what works, and the aim was to support their own technology integration and technology integration across the site at a pivotal time in the site's changing identity. Capturing this PLC process provides a descriptive case study of the complexities of technology integration and organizational change at one public TK-5th grade elementary school.

Population and sample. The San Francisco bay area is known as a tech industry hub, where high-paying jobs in the tech industry and large universities fuel high housing prices and widespread support of STEM initiatives in local public schools. One-to-one technology initiatives were on the rise in this context, across districts and schools with widely ranging resources. The bay area is home to affluent neighborhoods, socio-

economically disadvantaged neighborhoods, and mixes of both. Parkview¹, the school at the center of this study was a part of a “mixed” district serving both high socio-economic neighborhoods as well as several schools where the majority of students qualify for free and reduced lunch prices. The district was located in one of the counties adjacent to San Francisco and served over 6,500 students. The K-8 district included two middle schools and eight elementary schools. Schools in the district had been recognized as California Distinguished Schools and Blue Ribbon Schools, even as some of the same recognized schools had also been labeled as Program Improvement schools under the accountability practices of the now defunct *No Child Left Behind* act.

The school completed a three-year technology initiative building a one-to-one device program as outlined in the district’s 2012-2015 Technology Plan. The goal of one-to-one devices built on the successful accomplishment of its previous goal of reaching at least one computer lab at each of its ten school sites, a teacher laptop in each classroom, and 4:1 students to computers ratio.

Along with three other schools in this district, the school at the center of this study was classified as a Title 1 School based on its enrollment of students, 64% who qualified for free and reduced lunch in the 2016-2017 school year. Student demographics reflected those of California. Forty percent of the students were designated as English Learners the same year. The school had vacillated between accolades as a California Distinguished School in 2010 and being designated as a program improvement school after significant subgroups failed to make adequate yearly progress under *No Child Left Behind*

¹ The school name has been changed to protect the privacy of the site and participants.

accountability requirements. This change in status coincided with the closest neighboring school becoming a parent participation school for open enrollment in 2009. In the context of the district's open enrollment policies and declining enrollment at the school under study, the principal had been encouraged by district leadership to explore developing its own program to retain its neighborhood students as well as potentially attract students from overenrolled schools within the district.

In 2013, a group of six teachers at the site won a \$30,000 grant that supported teacher driven professional development. With the principal, they began to explore developing a technology and communication program that might be suitable as a district open enrollment choice. By 2015, the school had added several new partnerships in support of this vision. August of that year saw the completion of a fourteen-month, \$18 million bond-measure modernization project at the school that updated and upgraded all classrooms. By the middle of the 2015-2016 school year, the site reached its one-to-one technology initiative goal a year ahead of the district timeline due to additional investment of site funds, along with PTA and partnership support, which leveraged the district-allocated, per-pupil technology funds. In fall, 2016, the school's technology leads—a group of 6 self-selected teachers who had been meeting voluntarily with the principal—set the goal of getting on the spring open enrollment registration as a technology and communication program of choice in the district. It is in this context focused on leveraging a district-wide technology implementation plan to build its own capacity that teachers at the school were invited to participate in a voluntary technology PLC for this study.

Strategy for selecting site and participants. I selected the school site where I serve as the principal for this descriptive case study in order to examine how a technology PLC supported teacher growth and change in technology integration practices because it is a context where resources and support have been invested into classroom technology under informal teacher leadership and advisement over the three years leading to this study. Examining the development of human infrastructure to support teacher beliefs and practices in a school just as it was defining and publicizing its mission and goals around technology implementation provides a window into organizational interactions at a critical juncture in the process of change. Barriers and challenges arising in such a context would likely arise in other contexts as well. By the same token, structures and practices that facilitated teacher innovation in such a context may point to promising practices for the growing numbers of American schools undertaking the purchase and use of classroom digital devices in the wake of new computerized Common Core testing.

In order to mitigate my positionality and the potential evaluative aspects of the my dual roles in this study, teachers were selected based on non probationary status, service in technology leadership roles, special certification, or other training that helped to establish their expertise and to support their roles as participant-researchers. Of a total staff of twenty teachers and two full time instructional coaches, eleven teachers met the criteria for participation, and eight of these teachers taught in classrooms with one-to-one devices.

The tech PLC participants included six members who had demonstrated leadership through previous actions; they were tech leads for school, voluntarily Google Certified,

or had voluntarily participated in outside professional development sessions related to integrating technology into teaching. Their insider perspectives provided access to detailed knowledge of the kinds of organizational policies, interactions, and factors that could impact technology innovation at the classroom level. They would spearhead change because of their investment in paving the way for the rest of the school.

Because of my role as the evaluator at the school, there was a potential power imbalance that necessitated strategic sampling of teachers who could be on a higher footing and in a position to provide information and guidance within the study. In terms of skill and implementation, this sampling targeted teachers at the forefront of tech usage—a “great person” making a notable impact rather than the “marginal” or “ordinary person” (Creswell, 2013, p. 147). Instead of including a wide range of perspectives on integrating technology into teaching, the pragmatic goal of the study and my specific role at the school guided a strategic sampling of teachers. The teachers selected for this study were those leading technology implementation at the site, and their participation in the study was voluntary without any rewards or consequences attached. They could choose to leave the study at any time. These selection and participation criteria were detailed in the agreement form, a copy of which all participants received for their records.

I served as the school’s principal at the time of this study, and had been the administrator there for the previous five years. Recognizing potential biases and limitations associated with my insider’s perspective of researching the subjective and familiar context of my own practice, I attempted to address these limitations by scheduling regular check-ins with a “critical friend” (Anderson & Jones, 2000; Herr &

Anderson, 2015; Stake, 2010; Theoharis, 2007) as a part of the methodology design and study protocol.

The critical friend was the district's technology coach, a teacher on special assignment who supported all sites across the ten-school district with instructional technology use. Having supported the district's three-year one-to-one device initiative across the district's K-8 contexts, he was familiar with the range of technology use within the district as well as the site's work, having contributed to its conversations about integrating technology and supporting school-wide uses along the way of becoming a Tech school. In his professional role, he attended local and national technology conferences and worked with each site's technology leads to help them build their sites' capacity for technology use.

In his role in this study, the critical friend attended two of the PLC meetings—the first, which set up the parameters of the PLC, and the third, when teachers presented their students' work resulting from the PLC planning session. In addition, through the course of the study, I met with this critical friend before and after each tech PLC meeting to discuss a range of processes and findings as they evolved. Ten meetings totaling about twelve hours covered topics that included: reviewing surveys and interview questions for clarity, providing critical feedback about patterns found from site-level technology context survey results, weighing in on factors to consider in delineating my participant role, helping to brainstorm benefits and drawbacks of different ways of reviewing and analyzing transcripts, and looking over summaries and insights from ongoing analysis before they were shared with participants for the purpose of member-checking. As a

thought partner interested in both the topics of technology integration and professional learning communities, the district technology coach and critical friend provided me with opportunities for critical reflection and re-seeing familiar aspects of the context and data that were instrumental to the progress of this study.

Addressing ethical considerations: Access, reciprocity, trust, and rapport. All teachers on staff were told about the purpose of the study—to gather information about the school’s technology use through each teacher’s experience in order to guide the school’s decisions and vision, especially as related to bridging the digital use divide for equitable access to productive uses of technology. The invitation to join the tech PLC informed teachers that participation was voluntary with no positive or negative consequences resulting from their decision (see teacher consent form in Appendix A). During follow up interviews, teachers were in charge of the recording device and started and stopped the recording of their own interviews. The questions were designed to start generally and to be open-ended rather than leading. When questions stimulated answers related to another question, the order of the questions was switched for better continuity and flow. The study design included at least two weeks between each PLC meeting in order to provide time for analysis and sharing of analysis with the “critical friend” for feedback. Feedback meetings probed whether the evidence warranted confidence in the findings or if there was need for triangulation.

Member-checking at each PLC meeting regarding emerging patterns, themes, or understandings from the last meeting was included in the study design. Member checking also occurred with each teacher interviewed with written results from the interviews.

Limitations (Internal Validity Threats). The selection of the site for this study is a purposive case sample providing insider and participant-researcher input in describing the processes related to integrating a more formal, yet familiar structure of a PLC into the school's technology integration planning. It is the first use of the PLC structure in technology integration, an area that the school has focused on building capacity in the three years leading up to the study.

Researcher Stance. Educational research provides those who would engage in it the unique opportunity to conceive a project's methodology by drawing on a range of disciplines because "Education itself is not a single discipline but, rather, a field of study on which we bring to bear the various forms of disciplined inquiry" (Shulman, 1997 p. 24). Shulman describes disciplined inquiry as the research community's emphasis on ways of organizing data, arguments and reasoning in order to withstand "careful scrutiny by another member of the scientific community" (ibid., p. 9). An educational researcher must address five critical dimensions: the problem or topic, a setting in which to conduct research, the background and training of the investigators, specific methods used, and the guiding purpose or aim of the study.

The current study aims to describe how a technology PLC affects teacher beliefs and practices related to addressing the digital divide within the context of a public elementary school in the midst of developing its identity around technology integration. An important element of this descriptive case study is my role and perspective as the researcher. As the principal of the case study school, with almost six years at the site, and as a facilitator of its vision of becoming a "tech school," I played multiple roles and held

multiple identities within the context of this study. My unique role as supervisor, participant, and researcher informed the methodology in important ways.

Ethnographic and philosophic influences in this case study. Balancing a researcher's role as an "insider" or "other" in a group under study has long been a challenge for anthropologists using ethnographic methods.

The ethnographer walks a fine line. With too much distance and perspective, one is labeled aloof, remote, insensitive, superficial; with too much familiarity, empathy, or identification, one is suspected of having 'gone native.' The more successful fieldworkers resolve the tension between involvement and detachment; others go home early (Wolcott, 1997 p. 330-331).

Wolcott's description of the researcher who must balance between risking too much distance and 'going native' share a peculiar similarity with site administrators who strive to maintain a balanced perspective, to resolve tensions between involvement and impartiality with teachers under one's supervision. As principal, I also faced the challenges of trying to perceive and understand the culture of the school in which I worked from the ground level. I risked alienation through detachment and attempted to maintain a fresh perspective in a seemingly familiar context. In both cases—the case of the researcher and that of the principal—involving stakeholders as participants and co-researchers can offer a fresh perspective on problems of practice (Newberg, 1991).

Anthropologists maintain that most educational researchers face the challenge of engaging in the context of schools with a fresh perspective to some extent. Wolcott (1997) suggests that because most educational researchers have been in "more or less continuous contact in schools since about the age of six" (p. 331), educational anthropologists debate whether cross-cultural experiences should be prerequisite to

conducting ethnographically oriented research in schools in order to ensure having experienced “culture” in some conscious, comparative way. The critical element is the perspective a researcher is able to take in interpreting what she has seen. Taking on an ethnography-informed stance means maintaining a tentative one, one open to questions that may need asking. Looking to answer them requires “slowing our efforts and widening our gaze” (Wolcott, 1997 p. 337) as we work on “developing an ever-increasing capacity for examining fine detail” (p. 346). Through such lenses, “Ethnography reveals the general through the particular, the abstract through the concrete. Thus ethnography is not a license to generalize, it is a mandate to build, and build upon, a solid basis of careful description” (p. 347).

Careful description is a mainstay of case studies. In a case study, the researcher is trying to understand and interpret the case, using theme to discover what is meaningful to both researchers and to the case people. Stake (1997) calls the success of finding such unique and important stories to tell the “sweet water” a researcher seeks. He emphasizes perceptive and thoughtful description as a foundation for telling the story of the case in a thought-provoking way. Such rich description “reveals the perceptions and values of the people who belong to the case” (Stake, 1997, p. 404).

If careful descriptions are to offer authentic and valid insights to both readers and participants alike, the first challenge for researchers is to identify and understand one’s own lenses of perception and analysis. Compared with quantitative research, the challenge of qualitative research lies in striving for “adequacy of interpretation rather than prediction and control” (Greene, 1997 p. 189). In modern times, this standard for

adequate interpretation in educational contexts must also take into account the changing backgrounds of those involved. Embodying what Geertz (1983, cited in Greene, 1997) has called an unprecedented “diversity of modern thought,” educational researchers recognize that public schools are themselves facing unprecedented numbers of newcomers from diverse backgrounds. In this context, striving for consciousness, self-comprehension and radical self-investigation increasingly merges with the feminist perspective’s emphasis on contextualism, standpoint, relationality and narrative (Green, 1997).

One way to check the authenticity of my perceptions was to include them as data to share with participants as a co-participant myself. As an “insider in collaboration with other insiders,” (Herr & Anderson, 2015 p. 45), I borrowed from a tradition of autoethnography (Theoharis, 2007; Tierney, 1998) by including a reflective journal, kept through the length of the study, as a method of re-examining and potentially “reframing” theories in action after the actions have passed (Russell & Munby, 1997). In doing so this study combined qualitative, positioned-subjects methodology (Seale, 2004) while making room for the “reflective turn” that Schön (1991) describes as an “obligation” of researchers to recognize that their construction of practitioner reasoning “may be mistaken or radically incomplete (p. 357).

In order to avoid a flawed approach of avoiding rather than acknowledging my insider perspective, I employed tools to mitigate limitations associated with researching the subjective and familiar context of my own practice while capitalizing on the potential of more deeply examining my own “ongoing actions and shifting perceptions as an actor

within the setting as part of the research” (Herr & Anderson, 2015 p. 58). With ethnographic influences, a social-constructivist, positioned-subject, pragmatic frame of reference informed my researcher stance in this descriptive case study.

Positionality. Herr & Anderson (2015) recommend that the complexity of the researcher’s multiple roles be addressed and laid out from the beginning rather than being rendered invisible because “intense self-reflection...is the hallmark of good practitioner research.” They continue, “we believe that knowledge production from all positions is valid as long as one is honest and reflective about the limitations of one’s multiple positionalities and takes them into account methodologically” (p. 58-59). While the sampling of this specific school site provided the benefit of my insider knowledge of the organizational context and background of the school, my positionality posed as a potential intervening variable to collecting accurate and unbiased information about the effect of the PLC.

In order to help to mitigate this threat to the study’s validity, I took five precautions and steps to reduce or counterbalance my positionality. From the start, the selection of expert teacher participants on a “higher level” in terms of classroom technical training and experiences with technology integration set them up to be co-researchers in the study. Next, protocols mirrored the school’s common PLC practices and included explicit statements that participation in the study was voluntary and not linked to any type of evaluation, rewards, or consequences. Participants could quit without consequence at anytime through the study’s meetings. Third, participants themselves selected a participant-facilitator for future PLC meetings at the first meeting. Fourth, protocols for

member checking throughout the research process provided participants with regular opportunities to learn about my initial lenses and ideas for interpretation as they emerged. This gave them a voice in correcting any misrepresentations or misconceptions about what was happening in the group through the meetings. Finally, the incorporation of meetings with a “critical friend” on an outside review panel provided checks and balances as a precaution against hasty conclusions based on insider bias without sufficient evidence. In these ways, protocols were included to bring participants in as co-collaborators in the study and attempted to mitigate my positionality.

Early on in the study, having a participant facilitator allowed tech PLC members to take on the question of positionality head-on. Having given me a heads up that she would do so, the facilitator began the tech PLC release day meeting with a direct question to the participants about the ethics of the school’s funding of their substitutes for that day, which would provide “a lot of personal gain” from this “extra group.” After providing the group with a few moments of silence to think about the question, two members expressed having thought of this as well. Examining the question from the staff perspective, participants pointed out that the opportunity had been open to all teachers meeting the criteria—which was more than half the staff. Reflecting on the ethics of funding my dissertation study from an outsider’s perspective, the teachers reasoned that other special program schools in the district also used such release days to move their programs forward—that the funding didn’t seem out of the ordinary. Finally, the group agreed that the day’s work would be critical to the school’s imminent launch as a technology-focused school. It was worthwhile in its own right.

While I cannot ever truly know how my positionality in this study might have influenced the teachers' participation or interactions, some research (Robinson, 2008) suggests that educational organizations with professional orientations "constrain the use of positional authority." In such schools, "the professional orientation of [the school] culture stipulates that it must be the competence of the leader, rather than the leader's formal office, that legitimates the leader's power" (Robinson, 2008, p. 248). In a school where teachers were helping to develop the vision and signature practices, one could argue that the professional orientation would be relatively strong, providing some mitigating effects on the positionality associated with this study.

As an insider researching my own school site, I benefit from logistical advantages of access to information and insider, tacit knowledge. This tacit knowledge also raised epistemological challenges in the sense that "unexamined, tacit knowledge of a site" runs the risk of being impressionistic and biased. Assumptions and biases "need to be brought to the surface and examined" (Anderson & Jones, 2000 p. 443).

Keeping a researcher journal throughout the collection and analysis of data for this study allowed the possibility of following the course of decisions made to examine their impacts on the learning community and context. It also allowed for time to elapse between decisions and critical analysis of the thinking and motivations that influenced decisions, which may not be readily apparent to any leader in the moment of the decision.

Self-selection and self-report. The single site and self-selected participants in this study limit the generalizability of the study's findings and may exaggerate findings. Even though the goal of the study was to gain insights to the processes and factors that affected

tech integration capacity-building within an organizational context, the specificity of these factors may limit application across broader contexts. The rationale for this limited sample was to explore a single case in its complexity, to describe interactions between site-based factors indicated by research on technology integration. In this school, with supportive circumstances for potentially bridging the digital use divide, how did a technology PLC actually function for the group and for the broader context of the site? Examining the interactions and processes as they related to capacity-building within the context of the school shed light on how the PLC structure operated in comparison to its participants' aims. If challenges arose in this context selected for its support, they would be even more likely to arise under less supported contexts.

Participants' self report in both survey data and interview data collected brought with them the advantages and limitations associated with self-report. Specifically, primacy and recency effects, time pressure, and consistency motivation can influence credibility of self-report tools. Using multiple self-report tools across different time frames can help to mitigate some of these limitations. In the current study, a combination of multiple self-report tools at different points of time, including two surveys and individual interviews were included in the design to mitigate some of the limitations of self-report. Meanwhile, self-report tools remain a popular method because of their advantages of practicality, richness of information, general motivation to report, and causal force as self-perceptions influence respondents' identity and behaviors (Paulhus & Vazire, 2007).

Roles. My multiple roles in the case study school required employing strategies for examining assumptions about the process and outcomes observed. Member checking

during meetings throughout the process of data collection and initial analysis supported these efforts. In addition, the district technology coach, Paul², served as a “critical friend” who’s teacher perspective and role as the district technology coach helped me to question my assumptions and biases as they arose through data collection and initial analysis.

Preparing to meet with my critical friend nudged a deeper level of reflection from the very first meeting. After listening to the audio file of the first meeting several times in preparation for my critical friend meeting, it became clear that I needed to clarify the roles, actions, and decisions I would take on as a participant-observer. I noted the lack of “crosstalk” that happened when I spoke compared with when participants spoke, signaling a potential effect of inherent power dynamics. As a result, I decided to take on a least evaluative, least managing role in future meetings. Borrowing from Pascoe’s (2011) logic in her ethnographic study, my intention was to take into account my positionality to clarify my participation in future meetings. I then member-checked this decision.

In Pascoe’s (2011) ethnographic study of high school adolescent boys’, the author had to define and manage her role both as a female and an adult in a highly gender-conscious context while attempting to gain access and maintain ethical boundaries. Pascoe reasoned that a “least-adult” and “least-gendered” identity would allow her to maintain enough neutrality to study the interactions around her while maintaining enough rapport to gain access to those interactions in the first place. Her adult knowledge of “guy topics” gave her a privileged inside position. Meanwhile, down playing her gender gave her access to the naturalistic interactions that provided critical material for analysis.

² Name has been changed.

Using Pascoe’s logic in my own context, I defined my role to the participants as “least-managing” and “least evaluative”. This allowed me to access and use the cultural capital inherent in my principal position in order to help facilitate the group’s activities and decisions. Meanwhile, drawing limits—to participate when asked questions by the group as much as possible—aimed to serve and support the flow of the group’s collaboration and work by minimizing potentially disruptive interjections from their supervisor. I would refrain from giving input unless asked. This decision was positively acknowledged at the member checking process built into the next meeting. The goals of intentionally defining my multiple roles included clarity for the participants in the study and building my own self-awareness of the choices I would make while keeping in mind potential consequences and tracking outcomes (Herr & Anderson, 2015 p. 98).

Defining the PLC structure. Based on a familiar structure of grade level professional learning communities, the technology PLC was defined as an initial meeting to review school level data related to the topic—technology implementation—filled out by participants’ teacher peers in the school. From this data regarding the school technology context, the group selected a focus for investigating promising practices for bridging the digital use divide.

A release day was provided, which was longer than regular grade level PLC meetings, then the group implemented plans into classroom instruction before meeting again to share student work and results. Finally the group met to make adjustments and recommendations of next steps for the school.

In addition, participants understood that their work in the tech PLC would inform

school level decisions. The teacher participants selected a facilitator for the meetings at the end of the first meeting in order to allow me to limit my engagement to that of a participant-observer during the rest of the meetings.

In alignment with effective PLC factors, a pragmatic focus on group interactions, problem solving, and participants' reflections about how their practices supported technology innovation to support student-learning guided this study and my role in it.

Delimitations (External Validity Threats). This study was conducted with public-school teachers in the midst of developing technology integration practices to serve its majority low-socio economic population of students in a suburb of Northern California's bay area during the 2016-2017 school year. Therefore the findings and results may or may not generalize to other subpopulations, locations, or time periods.

Stakeholder insights. A pilot study involving interviews and observations of two teachers along with interviews with students in each class examined promising practices and potential barriers to technology implementation in spring, 2015 at the current study site. The pilot study informed site policies and helped to initiate the development of an informal tech leadership group at the school. This study's focus on a technology PLC draws its frameworks from a review of the literature in both technology implementation factors and effective PLC practices. Both were used as guides and frameworks for observing group interactions and for analyzing the group's construction of understandings and practices.

Focusing on the digital divide by supporting productive uses was aligned with the school's technology vision and provided an opportunity to clarify the vision. The district

tech coach was working on developing and supporting technology use amongst teachers as tech uses ranged widely within and across sites, if in existence at all. District level managers saw a site case study as informative about both technology implementation and about building shared leadership for change at the site level. Survey items were shared with two teachers to test clarity before being shared with the staff for completion.

Instrumentation to answer research questions. Data methods aimed to see the world as the research participants did—from the inside (Charmaz, 2014). In the case of participatory research and considering researcher positionality in this study, “triangulation, or the inclusion of multiple perspectives, guards against viewing events in simplistic or self-serving ways” (Herr & Anderson, 2015 p. 68) and was critical for safeguarding validity. This study included several methods of gathering information to help answer the three major research questions.

Research Question #1: How is a technology PLC associated with teacher beliefs and practices related to addressing the digital use divide? In order to investigate research question #1—how a technology PLC is associated with teachers’ beliefs and practices related to addressing the digital use divide—a combination of two surveys: a Technology Context Survey and Post-PLC Survey, with follow up interviews, were designed based on the integrated framework of technology innovation factors in a learning school context (Figure 4 on page 51).

The Technology Context Survey was designed and adapted largely from Zhao et al.’s (2002) model and the framework adapted by Groff & Mouza’s (2008) for predicting challenges to classroom technology innovation. It included a combination of 5-point

Likert scale questions, fill-in-the blank for some questions to gather more details based on the answers, and “check all that apply” questions to gauge knowledge and use of site specific resources and infrastructure. The five point Likert scales for beliefs or practice were organized along a continuum of 0 for unaware to 1 for I know of people at our school who use this, 2 I have considered or looked into this, 3 I intend to try the app this year and 4 I currently use it and plan to continue. Scales for agreement included five point scales that ranged from strongly disagree to strongly agree and included other ranges as well. The surveys were reviewed by the critical friend, who was the district’s technology coach, for clarity to teachers, to cut redundancy, and for usefulness for site planning to support. Four questions on the tech context survey allowed for comparisons of teachers’ use of specific applications in support of student learning, connections to their classroom instruction, and student roles and responsibilities related to specific technology uses.

In addition, a post PLC survey was created based on a PLC framework from the review of literature on effective PLC practices in order to gauge how participants’ experiences may have been related to changes in practice. It included 11 questions on the 5-point agreement scale described above with follow up questions allowing write-in responses to gather additional information. Surveys can be found in Appendix B and Appendix C.

Member checking discussions and post-PLC interview questions asked participants about their views of the digital use divide. These methods compliment PLC meeting observations, which are collected and analyzed with the observational framework for

PLC meetings in mind. See Table 1 for the instruments and guiding concepts related to research question #1.

Table 1.

Instruments and guiding concepts as related Research Question #1.

<i>RQ #1 How is participating in a tech PLC associated with teacher beliefs and practices related to addressing the digital use divide?</i>	
Practices related technology skills	<u>Tech Context Survey</u> <i>Pre and post comparison of Tech Context Survey</i> <ul style="list-style-type: none"> • Rating of use of applications of tech with students for learning
Beliefs related to pedagogy	Pre and post comparison of Tech Context Survey <ul style="list-style-type: none"> • Uses of technology in relation to classroom instruction
Beliefs and practices related to student agency	Pre and post comparison of Tech Context Survey <ul style="list-style-type: none"> • Student roles in using technology • Student responsibilities in using technology
Bridging the digital use divide	<u>Tech Context Survey</u> <ul style="list-style-type: none"> • Aspects of student technology use <u>Interview</u> <ul style="list-style-type: none"> • Experiences that have informed teachers' thoughts and feelings about technology integration in schools • Teachers' sense of the school's biggest strengths and challenges in technology integration, in light of the digital use divide? • Teachers' description of the significance of the tech PLC on technology integration <u>Observation & Audio Recording of PLC Meetings</u> <ul style="list-style-type: none"> • Factors impacting reflective practice: questions, plans, follow through, participation of group members

Note: Survey, interview, and observational frameworks available in Appendices.

The Technology Context Survey pre to post comparisons provided information about the landscape of individual and group beliefs and practices in terms of technology use as a site and for the tech PLC group before and after the PLC. Analysis of changes among

these various elements also provided clues that observation notes, meeting transcripts, post PLC survey responses, and interviews helped to clarify and expand. Using coding informed by the frameworks for technology innovation factors and effective PLCs, themes and patterns were induced and informed by participant member-checking multiple times over the course of the study. Input from member checking was incorporated through review and re-analysis of the relevant data.

Research Question #2: What are the aspects of the PLC that facilitate teachers' innovative practices related to addressing the digital use divide? In order to examine participants' experiences of inclusion or exclusion, collaborative or isolated innovation, and other aspects which may have been related to their beliefs and actions in regards to addressing the digital use divide, a post-PLC survey with 5 point scaled agree/ disagree responses and several write-in opportunities to explain responses explored how aspects of the PLC process and interactions varied across members in terms of experience of the PLC and extent of learning or implementation of new practices. Follow up Interview questions were loosely structured with twelve guiding questions. The questions asked about aspects that influenced teachers' beliefs and practices in addressing the digital use divide and about the PLC impact on relationships or interactions related to technology sharing or support. (See Appendix D.) These data were also meant to complement and inform analysis of PLC meeting notes, informed by the PLC observational framework (See Appendix E). In addition, the researcher reflection journal was kept to focus on decisions, dilemmas, emerging understandings and analyses that came up in order to facilitate member-checking follow up where possible. See Table 2 for an overview of the

instruments and guiding concepts for analyzing the aspects of the PLC that limit or challenge teachers' innovation related to the digital use divide.

Table 2.

Instruments and guiding concepts as related Research Question #2.

<i>RQ #2 What are the aspects of the PLC that facilitate teachers' innovative practices related to addressing the digital use divide?</i>	
Inclusion as related to impacting practice	<u>Post-PLC Survey</u> <ul style="list-style-type: none"> • Inclusion of each member • Collaborative decision making • New practices in classroom, impact on student learning <u>Interview</u> <ul style="list-style-type: none"> • What was participating in the tech PLC like? • What contributed to or took away from the group's inclusiveness? <u>Observation and audio recording of PLC Meetings</u> <ul style="list-style-type: none"> • Factors impacting Inclusion: participation
Collective problem solving as related to successful innovation	<u>Post-PLC Survey</u> <ul style="list-style-type: none"> • Communication for problem solving • Success of new practices in classroom <u>Interview</u> <ul style="list-style-type: none"> • Moments of honest sharing or problem solving <u>Observation and audio recording of PLC Meetings</u> <ul style="list-style-type: none"> • Factors affecting Collaborative Problem Solving
Other Aspects related to beliefs & practices related to bridging the divide	<u>Interview</u> <ul style="list-style-type: none"> • What led teacher to join the tech-focused PLC • How PLC group affected views or interactions with students around technology use • PLC influences on view of own role in supporting tech integration at the school

Note: Survey, interview, and observational frameworks available in Appendices.

These data provided ways to compare individual to group experiences of the PLC and made connections between those experiences and teachers' implementation of innovative practices to address the digital use divide.

In addition, an analysis of the interactions between the tech PLC members allowed for a closer look at patterns to provide insights on unspoken rules and the functions and types of participation facilitated by them. Ethnographic studies of the naturalistic exchanges in educational settings have led to understandings of how those involved in regular exchanges construct meaning through their interactions. In a study of classroom discourse, Mehan (1979) used such ethnomethodology to uncover and analyze co-created meanings involved in a common interactional routine found in the classroom, which he called the “Initiation-Reply-Evaluation” sequence. Building on the co-construction of understandings based on such mundane, yet ubiquitous, classroom routines Macbeth (2003) described how even a delay in the turn transition between fourth grade students’ replies and the teacher’s evaluation could prompt students to conclude their replies were incorrect and continue to search for other ways of answering their teacher’s questions about fractions.

Similarly, interactional analysis of naturalistic teacher talk during collaboration meetings (Little, 2002; Horn & Little, 2010) have given insights into the types of teacher interactions and collaborative contexts that build professional knowledge around problems of practice as well as those that close them down.

Building on these methods and understandings, analysis of teachers’ talk during the Tech PLC meetings, along with information gathered from the post-PLC survey and follow-up interviews helped to provide insights about specific aspects of the PLC which helped to facilitate teachers’ innovative practices. Development in teachers’ beliefs and practices at a key intersections with the school’s organizational context came to light

through an examination of the school's context and teachers' specific interactions across the tech PLC meetings.

Research Question #3: What are the interactions between school-based context factors and teacher collaboration and learning in the PLC? Learning how the PLC fit into other context factors experienced by participants helped to paint a more detailed picture of the school context and interactions between site-level factors and a site based technology PLC. Again, a combination of Technology Context survey data, post-PLC survey data, observations and interview questions attempted to capture and tease out the factors most salient to the participants as they were going through a collaborative process of learning and innovation. Table 3 provides a summary of the instruments and concepts used to capture and analyze data as related to this research question.

Because these measurement instruments were based on empirical and theoretical frameworks as well as specific context factors, there is no reliability or validity data available for their use. In terms of meeting such reliability and validity standards in research, it is important to keep in mind that "rigorous application of the Standards to...the broad range of unstructured behavior...is generally not possible. It is useful to distinguish between devices that lay claim to the concepts and techniques of the field of educational and psychological testing and devices that represent ...less standardized aides to day-to-day evaluative decisions (AERA, 2014, p. 2). With low individual stakes and emerging behaviors and correlations under investigation for this study, these instruments were created to provide some lenses on correlations and interactions to guide and inform the various methods of data collection.

Table 3.

Instruments and guiding concepts as related Research Question #3.

<i>RQ #3 What are the interactions between school-based context factors and teacher collaboration and learning in the PLC?</i>	
Organizational Context factors experienced by staff vs. PLC group	<p><u>Survey</u> comparison between staff & PLC participants</p> <ul style="list-style-type: none"> • Support of grade level team on tech integration • Alternative learning supports • Access to human infrastructure at site • Perceptions of student tech background & understandings
Interactions between PLC and organizational context factors	<p><u>Survey</u></p> <ul style="list-style-type: none"> • Affect of PLC on school connections • Confidence to share new learning with others
Interactions between PLC and organizational context factors	<p><u>Interview</u></p> <ul style="list-style-type: none"> • Description of PLC's affect on addressing the digital use divide • Hoped for outcomes of the PLC <p><u>Observation and audio recording of PLC Meetings</u></p> <ul style="list-style-type: none"> • Interactions: references to shared activities, understandings or interactions • School culture: human infrastructure, supports • Leadership: vision, policies, resources

Note: Survey, interview, and observational frameworks available in Appendix.

Sources of information. Transcripts of meetings, interviews, and archival data were used for establishing the recent history and context of the school's technology implementation, student demographics, and technology policies. Extant records included plans and policies posted on the school, district, and county websites, archived emails, and other school records shared via cloud-based staff folders.

In addition, elicited documents produced by participants while participating in the

PLC cycle such as jointly created resources or other related communications were also used to provide data details or triangulation where needed as examples, clarification, or evidence of emerging findings.

Data collection procedures. In October of 2016, I provided the school staff with an overview of the technology PLC and criteria for voluntary participation. The tech PLC would inform school policies and serve as a case study of how organizational context factors interact with a site based learning community to affect technology implementation at the site. The Technology Context survey was conducted at that October 26 staff meeting, and a verbal reminder about emailing interest in participation was given. Within the next week interested participants were provided with the participant agreement. On November 8, the first after school tech PLC meeting met for an hour to set goals and deciding on measures, if any, to help the group plan instruction to meet the goals. A meeting with the critical friend was set for a week after the first meeting to support analysis and prepare the researcher for member checking at the next collaboration meeting.

Almost two weeks later a release day was provided to the tech PLC on November 21st for data sharing and planning. It included time set aside for member checking at the end. Again, meeting with the critical friend was scheduled for later in the week to support analysis before the next meeting. Meanwhile school grade level PLCs finished their cycle of inquiry at the end of November before the tech PLC met on January 11 to share and analyze student samples for adjustments to their plans. Again, the first fifteen minutes were reserved for member checking analysis and findings. Before the last Tech PLC

meeting on January 25, another critical friend meeting was arranged to go over findings and to prepare for the final whole group member checking round. Based on participation data, two PLC participants were selected as mini-cases to describe the most diverse experiences of the PLC. These interviews were conducted on February 3 and 10, with a critical friend meeting on February 17 and final member checking with the interviewees on March 3.

Because of the time needed for transcription of meeting audio files, in depth coding and analysis of PLC interactions was conducted after the final PLC meeting and after individual interviews. Once the data analysis was completed, the results and a draft of the findings were emailed to all participants with the offer to meet with any participants who wanted to discuss them at a set time on a day about a week after I sent the draft out. Four of the six participants met with me. They expressed surprise at the level of detail of the interactional analysis of the transcripts. The group expressed agreement that the analysis captured a new, yet authentic understanding of the group's PLC collaboration. The post-PLC member checking of interactional analysis findings, along with participants' responses, lend validity to the authenticity of the findings since participants were not aware of the type of analysis that would ultimately take place until after the final meetings were over.

Data analysis procedures. Coming from a pragmatist focus on the social construction of understanding and knowledge, this case study mirrors the existential and constructivist epistemology of qualitative researchers as (Stake, 2010). Through its mixed methods design I attempted to gather, through a variety of corresponding data,

information to answer each of the three research questions. Tables 1-3 have provided a roadmap of the methods used for answering each of the research questions. Copies of the instruments and protocols are included in Appendix A-E.

Data analysis techniques were informed by social constructionist grounded theory (Charmaz, 2014) and case study coding (Creswell, 2013) to make sense of the complexity of technological innovation and the processes supporting it at the school level.

As is common in case studies and ethnographies, this study engaged participants in “member checking” by soliciting participants’ views of the accuracy of information and credibility of the findings and interpretations, including emerging themes or patterns from observations and interviews regarding the PLC process and impact (Creswell, 2013; Herr & Anderson, 2015; Robinson & Lai, 2006; Stake, 1995).

Stake (1995) reminds us that description is the purpose of case study methodology; “The function of research is not necessarily to map and conquer the world but to sophisticate the beholding of it. Rich descriptions including ‘experiential understanding’ and ‘multiple realities’ are expected in qualitative case studies” (Stake, 1995 p. 43).

In order to capture the rich description of the technological innovation process as facilitated by a tech PLC, interviews and meeting transcripts were coded in order to condense and reduce the data into themes. While memo-writing is an organizing element of the “constant comparative method” of grounded theory (Charmaz, 2014 p. 18-19), it is also essential for the participant researcher (Herr & Anderson, 2015).

Qualitative researchers (Stake, 1995, 1997, 2010; Herr & Anderson, 2015) agree that the pursuit of complex meanings cannot be just designed into the data gathering or caught

retrospectively. “It requires continuous attention...an ongoing interpretive role of the researcher is prominent in qualitative case study” (Stake, 1995 p. 43). As a participant and researcher in this study, I kept my own role and subjectivity in the foreground through data collection and analysis, which required continuous attention. Including an autoethnographic component in the form of a reflective journal provided critical information about my leadership actions, decisions and rationale as well as the space to examine consequences based on other data gathered (Theoharis, 2007).

This study employed a design method to help mitigate critical subjectivity by incorporating validation meetings in which ongoing findings were defended before one or more critical friends who served as a kind of devil’s advocate (Anderson & Jones, 2000; Herr & Anderson, 2015; Theoharis, 2007). Stake (2010) also recommends critical friends as a way of improving quality by seizing opportunities to confirm and challenge meanings of developing issues and relationships in qualitative studies (p. 128). When these meetings are with “auditors” with no connection to the study in order to examine whether or not the findings, interpretations, and conclusions are supported by the data, they are considered “external audits” (Creswell, 2013). Such audits or review panels are important means for triangulation of data through “multiple eyes” (Stake, 1995 p. 127) through the data analysis spiral (Creswell, 2013).

Quantitative procedures. Survey analysis procedures included descriptive statistics to provide some information about how the PLC experience was associated with participants’ beliefs and actions related to addressing the digital use divide and their sense of connection to the technology infrastructure at the site before and after being part

of the PLC. Google Forms (Internet-based surveys) were used to collect and graph staff responses to the Technology Context Survey for the first tech PLC meeting. Coding and analysis software MAXQDA12 and Excel were used to code meeting transcripts and to analyze associations among coded segments and participation.

Qualitative procedures. One of the challenges inherent in case studies is the narrowness in scope of the research focus. Purposeful sampling must reflect strong rationale for selection of the case. As an insider to the particular case of this study, I had access to information for forming a more in-depth picture of the case, which can otherwise pose as a limitation (Creswell, 2013). However, as an insider, tacit knowledge of the context must be brought to light in order to critically examine assumptions and biases (Anderson & Jones, 2000).

As both the principal investigator and administrator at the site of study, I needed to address positionality and bias through ongoing habits of self-reflexivity. Herr and Anderson (2013) introduce *critical subjectivity* as an approach to validity used in humanistic psychology. Critical subjectivity is the acknowledgement that all researchers enter research with a perspective drawn from our own unique experiences (Herr & Anderson, 2013, p. 73).

Recognizing one's critical subjectivity makes articulating personal perspectives and biases as clearly and completely as possible a critical consideration from the start. In order to structure reflexivity into the study, evolving perspectives were articulated in a researcher journal for field notes throughout the process. In addition, mechanisms such as member checks and validation meetings with a critical friend were included at regular

intervals. “To the extent that action researchers have positions high in the institutional hierarchy or are high-status outside change agents, such mechanisms become increasingly important” (Herr & Anderson, 2013 p. 74). At stake were issues of credibility. Charmaz (2014) reminds researchers that criteria for credibility include whether systematic comparisons between observations, categories and empirical evidence have established strong logical links to substantiate claims to allow another reader to form a concurring independent assessment.

When addressing questions of whether such findings might be generalizable, the work of Robert Stake (1986), Lincoln and Guba (1985), and Greenwood and Levin (2006) all move to reframe this quantitative research concept of generalizability. Instead they describe a “notion of transferability, in which findings are not generalized, but transferred from a sending context to a receiving context” (Herr and Anderson, 2013 p. 75). If efforts to mitigate potential bias and positional influence can lead to a description of the context and happenings in ways that resonate with participants; if logical links concur with outside perspectives; then “a disciplined study of the particular” has “provided an opportunity to understand an interesting part of how the thing works” (Stake, 2010 p. 57).

Chapter Four

Findings

Introduction

This descriptive case study spotlights a Professional Learning Community focused on technology integration at a school in the midst of defining the school's signature technology integration practices with a focus on bridging the digital use divide. The purpose of this case study was to examine the interactions and outcomes of a site-level PLC organized around technology implementation. Specifically, the case was designed to better understand:

1. How is participation in a technology PLC associated with teacher beliefs and practices related to addressing the digital use divide?
2. What are the aspects of the PLC that facilitate teachers' innovative practices related to addressing the digital use divide?
3. What are the interactions between school-based context factors and teacher collaboration and learning in the PLC?

This case study took place at Parkview School³, a public elementary school in California during the 2016-2017 school year. In October, the researcher presented the school staff with criteria for voluntary participation in a technology PLC that would inform school policies and practices. Six teachers volunteered to participate in a technology PLC, given the criteria of either having attended at least one outside training focused on technology integration, serving or having served as a site technology lead on

³ The names of the school and study participants have been changed.

the district's technology steering committee, or having completed Google Educator Certification (Level 1).

The tech PLC cycle paralleled the school's grade level PLC process. The cycle was broken up into a total of 4 meetings that took place between November and January. Each meeting was organized around a specific goal: an initial meeting for the group to examine school data in order to determine its purpose and select a facilitator, a second meeting which involved release time for planning towards the group's purpose, and a third meeting to share student work as a result of the planning session. In addition, this tech PLC added a fourth meeting to allow time for discussion about next steps in relation to supporting technology integration at the site and to debrief the process.

Brief Narrative Description of the Participants

All six participants attended all of the meetings. Five were classroom teachers spanning grades two through five and one was the school's instructional coach. The group was comprised of five females and one male with experience ranging from four years to twenty years. The average was ten and a half years. Five of the six participants had been teaching at the school for their entire teaching careers and had been part of initial conversations about becoming a technology-focused school three years prior to the study. Below are brief summaries of each participant's teaching background and experience related to the school and this study.

Amy was in her third year as the school's instructional coach at the time of the study, having taught at the school for twelve years prior to taking on the full-time released position. Serving in her role of supporting the school's English Learners, Amy's

responsibilities included, but was not limited to: supporting grade level PLCs in sharing and exploring effective practices, training and checking in with instructional aides on the impacts of their small group interventions, helping teams to monitor student learning to identify students struggling to make academic progress, and coordinating interventions to support students' needs. Amy also worked with individual teachers in coaching cycles (varying combinations of modeling, co-planning, and observing teachers to provide feedback) based on school goals and teacher input. She had been one of the original drivers behind the school's decision to focus on technology implementation and to develop tech focused signature practices into a program of choice in the district.

Out of the tech PLC participants, Janine had been at the school the longest—twenty years—and taught in the primary grades. While she had always been a less outspoken member of the school staff, she had become engaged in helping to develop the technology vision early on in the school's discussions about becoming a technology-focused program of choice in the district. After becoming a regular at various technology conferences and workshops, she became one of the school's technology leads and was in her third year in the role at the time of the study. When she had first started out as a technology lead, presenting to the staff had been a challenge: "I am not a presenter. [When I do present], I'm very, very nervous." Yet her calm, "if I can do it, then you can definitely do it, too" attitude and style had supported some of her more technology-anxious peers to venture out of their comfort zones and try new applications. As a tech lead, Janine regularly looked for opportunities to build her own students' technology skills and send them back to their previous teachers to present their learning or to provide

push-in support of younger students learning new tech skills. Based on her part in the school's technology development, and because Janine's participation during the PLC was characteristically more quiet compared with others, she was invited to an individual follow up interview after the last PLC meeting.

Julia was a grade level-colleague of Janine's, and had been at the school for fourteen years at the time of the study. Having switched careers to become a teacher, Julia had come from a corporate background and also enjoyed performing in a professional choir outside of school. She shared this interest with students at the school by teaching a recess-time choir and coordinating performances for grade level teams and for the after school program. Three years earlier, Julia had been part of initial discussions about what type of program of choice the school should become. At the time she had strongly advocated for the school becoming a performing arts school and had voiced some concerns about pursuing technology instead. Since then, she had become a member of the local chapter of Computer Using Educators (CUE), attended summertime Google Educator Summits, and volunteered for school level meetings soliciting teacher input about technology investments, deployment, and next steps in becoming a technology-focused school. Julia was nominated to be the tech PLC's facilitator during the first meeting. As the facilitator and as a member who had originally objected to the technology focus of the school, Julia was also interviewed individually after the PLC cycle ended.

Sara was in her fifth year of teaching at Parkview School and had originally been hired for another school in the district. When enrollment numbers differed from

expectations the year that Sara was hired, she was transferred to Parkview in the fall just prior to the start of the school year. In the relatively short time that Sara had joined the school, she had taken on a variety of leadership roles. She was serving in her first year as a school tech lead during the year that the study took place. Sara described herself as “passionate” about technology integration and had also been part of early conversations about the school becoming a technology-focused school. She had voluntarily attended school level meetings to provide input on technology investment and next steps for supporting the staff. She was one of three tech leads at the school during the year of the study. Sara had attended Google Summits over three summers—the most recent summer with Mark, who joined Parkview the year that this study took place.

Tina was the youngest member of the tech PLC in her fourth year of teaching at Parkview. As the school’s Parent-Teacher Association (PTA) teacher representative from early on in her tenure, she had helped to build the school’s PTA participation and leadership, along with Amy, who was also an active member. Parent engagement was a particular passion and strength of Amy’s as she regularly reached out and met with the parents of her most vulnerable and struggling students, as well as the parents of students who excelled. She had a steady stream of volunteers in her classroom, which was unusual at a school serving mostly working-class families. Tina’s willingness to help out whenever needed made her someone that teachers and community members often approached for support. Tina had attended two Google summits over two summers.

Mark, the sixth and only male participant had started at another school in the district five years prior to the study, built up a strong reputation and then applied for a transfer in

the spring of 2016 when one of the study site's teachers announced her retirement. In May, prior to his official start at the school the following fall, he participated in a daylong planning session with a cross-grade level, voluntary tech steering committee, which had included five of the six tech PLC participants in this study.

Together, the team had spent a day developing learning progressions and organizing resources for supporting school wide cyber-safety lessons, typing skills for grades 2-5, emailing skills for grades 3-5 and basic ipad foundational skills for grades K-2. The release day had been organized to develop resources to support teachers with implementation over the course of the year that this study took place—the year the school officially launched as a technology-focused program.

Even as a newcomer to the site, Mark helped take a lead in finding and sharing resources on that planning day. Having been a site technology lead at his previous school, he continued to serve as one of Parkview's teacher tech leads during his first year there. Mark had been classmates with Sara in their credentialing program, and had attended Parkview as a child himself. Because of his unique perspective as a new staff member at the site, and because he was one of the two participants who had the fewest utterances recorded across PLC meetings, Mark was also interviewed individually after the tech PLC ended.

As a group, the tech PLC members mirrored the school's teachers in terms of years of experience and gender. About half of the school staff had joined the school over the past five years and about a third of the teaching staff were male. In terms of active participation or leadership in the school, community, or school district, the tech PLC

participants were more active in more areas. However, this was also somewhat representative of the school. As often occurs with district and school committees needing representatives, a small school staff often needs to distribute leadership and participation more widely. Out of twenty-two teachers, 75-80% of Parkview School staff regularly took on some kind of school or district committee role. In terms of technology training, the group was more widely trained. Based on the criteria for participating in the study, 86% of the staff was eligible to participate. Five out of the six participants (83%) had completed Google Educator Certification, Level 1 at the time of the study compared with 60% of the school's teaching staff.

Description of Results: From Survey Data to PLC Goals, Artifacts, and Plans

A technology context survey was given to the school teaching staff during an October staff meeting and taken by all 22 teachers ranging from TK-5th grade, including three special education teachers and the school's instructional coach. Questions on the survey asked for teacher perceptions of the school's technology context based on critical conditions for technology integration cited in the literature. The surveyed conditions included: available networks of support, responsiveness of supports, teachers' skills and comfort level using available applications, views of student responsibility in using technology, and sense of students' familiarity with and use of technology to create digital products. See Appendix B for the Tech Context Survey that was given. The tech PLC participants took the same survey again at the end of the tech PLC cycle for comparison.

The six participants of the Technology PLC reviewed aggregate staff survey data at the first Tech PLC meeting to help them determine what they would focus on for their

release time and overall collaboration. At that first meeting, I presented overall trends from the survey, highlighting the school's growing capacity to support the use of educational technology. The group noted the fact that teachers had reported asking their grade level teammates for help with instructional technology (76.2%) more than they did the district IT support (71.4%), who had always been considered the go-to person before.

As they examined what teachers reported using in their classes, what teachers reported intending to try in the current year, and teachers' perceptions of their students' skills across different applications, the group's attention turned quickly to the survey responses about digital presentations. What struck the Tech PLC team was that only 13.6% of all staff members (or three teachers, including the Tech PLC participants themselves) believed that "most students are competent and can support others" with digital presentations. This didn't seem to fit with the fact that 45% of teachers reported using presentation applications and another 18% reported intending to use it the coming year.

This conversation sparked exploration leading to a collective realization that the survey may not have captured the staff's real use of "presentations" and that a clearer definition of digital presentations was needed. Further, the tech PLC decided that the definition needed to include both the technology-related aspects of creating a digital presentation (making and formatting slides) as well as social elements involved with communicating it to an audience (delivery, eye contact, interaction with the audience). All agreed that in order to accomplish the work of creating and testing out a presentation rubric, they would need to streamline the process. Eventually, they decided they could do

this by integrating the teaching of digital presentation into whatever topics in whatever content areas they could most easily combine with the tech project. This flexibility to integrate a digital presentation into any content area would allow participants to record students' actual deliveries of the digital presentations to bring back to the group.

In hindsight, an important shared experience among the participants likely influenced the group's quick inclination to examine staff use of "presentations" at this first meeting. Five of the six participants had been part of a tech planning day the previous spring (a precursor to the tech PLC of this study), when digital presentation had been a topic that the group had intended to plan together, but time ran out before they could do so after planning other topics first (cyber safety, typing, email, and ipad skills). Without mention of this shared experience until later in the PLC cycle, the group nonetheless quickly zeroed in on the idea of using the tech PLC release time to create a shared rubric for teaching digital presentation, similar to the work they had previously taken on.

Creating a shared rubric for joint use had been a goal set during that prior planning day, with a focus on supporting and aligning school-wide technology use. Although "technology use" spans a wide range of applications and skills, organizing learning progressions for the technology uses and applications that were already taking root at the school in order to align explicit instruction and consistent definitions of proficiency had been the group's goal in their planning and work that previous spring. At the time, they had described it as "harvesting the low-hanging fruit" to align practices and to ensure site-wide access for students. By defining core technology skill competencies and aligning them across grade levels, and by making actual "badges" (pin-backed buttons)

for students to earn based on those competency standards, the teachers were consciously moving away from pockets of access according to individual teachers' comfort levels, towards equal access to tech-related competencies for all students.

In a post PLC interview, Mark referenced the previous spring's planning meeting when asked how he thought the group had so quickly honed in on developing a digital presentations rubric together during the first tech PLC meeting.

Mark: Well, I can't speak for everyone else, but I knew it was something we were currently working on in my class and Sara could say the same thing. It was something that we already have been observing. Then it went back to that [planning day] that we had a year ago when we just couldn't even get a foundation set up for what [the requirements for] a presentation [proficiency] badge should look like. That troubled me because the typing badge, cyber safety, email, everything else came so easily. It made a lot of sense to take on presentation skills, which is probably the most important skill of all. It's like we couldn't even get started [back then].

This sentiment of unfinished business was echoed by Sara during the latter half of the PLC release day as the rubric was coming together.

Julia: I'm really excited about this, this rubric, guys. I think it's pretty awesome.

Sara: I mean, this is the one we were scared about last year.

Julia: So after the rubric, now are we going to design lessons? Okay.

Based on PLC meeting discussions and post PLC surveys, participants in the tech PLC indicated that setting aside the time to align learning goals before trying out technology integration could serve dual purposes of building the tech PLC group's capacity and paving the way for supporting the rest of the school towards an application that, according to the staff survey results, many were already thinking about using but unsure of how to implement. At the end of the first voluntary meeting, all six participants

signed up for the study, elected a teacher facilitator for the rest of the meetings, and determined the resources that the group would need to bring in order to make the most of their upcoming release day towards the goal of creating a rubric for digital presentations.

About two weeks later during the Tech PLC release day, all six teachers spent the day in the school's conference room dropping digital resources they had brought into shared folders, projecting folders and documents on the room's LCD screen, and then discussing and deciding which they would use as their core reference materials to make their own rubric. By the end of the six and a half hour day, they collaboratively talked through and built Presentation Rubrics for grades 3-5 and for grades 1-2, with skills and competencies mapped across grade levels.

After four weeks of instruction, the group met again in January to share videos of their students giving digital presentations in order to test the rubric and to see the skills progression across the second, third, and fifth grades, which were represented in the Tech PLC. Four out of five classroom teachers shared. The second grade teacher who was still in the midst of the unit, and the instructional coach, did not share.

The final Tech PLC meeting turned to the work of brainstorming staff needs and developing a plan to support further school-wide technology integration in line with the school's vision, goals, and newly developed resources. Aspects of the plan were calendared into future staff meetings, in-service opportunities, and the following year's professional development plan. The last meeting also allowed time for participants to take a post PLC survey and the technology context survey for the second time. In terms of changes in practices before and after the Tech PLC, four out of the six participants

(66.7%) had taught digital presentations before the tech PLC. This experience was almost double the ratio of the rest of the staff (37.5%). By the end, one more joined in teaching digital presentations (83.3%) with the last participant—the instructional coach—intending to do so that year.

RQ #1: How is Participating in a Tech PLC Associated with Teacher Beliefs and Practices Related to Addressing the Digital Use Divide?

This first research question set out to examine how a PLC is associated with teachers' belief and practices about the digital use divide. While the work resulting from the PLC brought productive, high-level technology use to the level of the students within the participants' classrooms, it did not drill down and directly address the digital use divide. Yes, the students' production of digital slide presentations on different applications involved the 21st century skills of collaboration, critical thinking, creativity, and communication. However, no data about students' home access or previous experience with technology was taken, and participants' planning and instruction were not targeted specifically to close any gaps found. Rather, participants focused on addressing equity of access by planning for school-wide integration of one type of student productive use of technology. And they happened to teach in a Title 1 School, where 64% of the students qualify for free and reduced lunch.

By several of the participants' own admission, the concept of digital use divide did not drive their work in the PLC; student access to relevant and engaging technology skills and applications did. Data about student use and access did not determine their focus and goals in the PLC; data about teacher use, beliefs and readiness to embed specific applications into learning did. The teachers did not dissect digital use in order to

intervene with new applications to specifically target passive student uses. They aimed to guide and strengthen the integration of one type of active student technology use in a planned progression. By getting away from the haphazard reality of technology integration dependent on individual teacher beliefs and efforts, they would broaden access to higher levels of integration, instruction, and more rigorous expectations of student technology use across the school. Moreover, those expectations could be explicitly shared with students to support their own long-term learning. This work is necessary for eventually bridging the digital use divide; but it did not, on its own, do so just yet.

As such, this tech PLC study did not directly address teacher beliefs and practices surrounding the digital use divide. Instead, it raised questions about how, within the context of a PLC, teachers communicated with each other, negotiated their beliefs, and used conversational cues to move forward through the process in order to better align their beliefs and practices about technology integration—which remains challenging in its ever-changing, and wide-ranging definitions. I started with one question about digital use divide and ended up answering a different but related question about aligned, high-level technology integration at a Title 1 School. Addressing this question first could build a foundation for eventually addressing the digital use divide across the school site.

To this purpose, participants set a goal of determining a learning progression for the teaching of digital presentations such as PowerPoint and Google Slides based on data from a staff survey of technology use and the tech PLC participants' own tech skills and experiences. They wanted to vertically align skills by grade level for school-wide use.

The rubrics they created through the PLC were designed in descending order from fifth to first grade in order to backwards map the progression to fifth grade, when students would be promoted to middle school. See Figure 6 for a sample of the tech skill progression. The progression in Figure 6 is supplementary of additional presentation rubrics that the group created, which included more detailed descriptions of presentation design, content organization, and verbal and non-verbal delivery (See Appendixes G and H Presentation Rubrics).

Teachers in the tech PLC used the progression and their grade-span rubrics to plan and teach students how to create a digital presentation and how to deliver it effectively in front of an audience. Four out of the five of the classroom teachers in the tech PLC shared videotaped student presentations at the third PLC meeting. The group collaboratively scored the presentations with the rubrics at this meeting. At the last meeting, the tech PLC planned how to use the rubrics and videos of student presentations to support school-wide implementation the following school year.

A post PLC survey designed to measure elements of an effective PLC was given at the end of the final PLC meeting. Survey questions were based on a framework for effective PLCs, as defined in the literature review in Chapter 2. The framework for analyzing PLC effectiveness included four critical elements: focus on student learning (DuFour, 2004; Hord, 1997), inclusiveness (Little, 2012; Louis & Marks, 1998), joint problem-solving based on data about teachers' and students' needs (Horn & Little, 2010; Little, 2002; Senge, 2012; Stoll et al., 2006), and potential for building capacity for distributed leadership at the site (Harris, 2008; Robinson, 2008; Spillane, 2001).

	5th Grade	3rd Grade	2nd Grade
Technology Skills Progression (By Grade level)	<p>Aligns text, font style and size for theme or emphasis.</p> <p>Strategically includes and edit pictures, charts and graphics to illustrate key points.</p> <p>Insert songs, videos, or other media on slides for effect.</p> <p>Inserts effective transitions that support flow and focus of message (transitions from slide to slide, on-click transitions)</p>	<p>Can modify the text style and font.</p> <p>Can insert pictures, charts, and graphics to illustrate key points.</p> <p>Introduce students to: transitions, videos, songs and other graphics.</p>	<p>Can produce and modify text style and font.</p> <p>With help as needed can find insert pictures and graphics to illustrate key points.</p> <p>Expose students to: transitions, videos, songs and other graphics.</p>

Figure 6. A portion of the Scope of Presentation Tech Skills representing the grade levels of student work represented at the tech PLC. This Scope of Presentation Tech Skills was created by the Tech PLC along with rubrics for scoring student presentations in the areas of Verbal Delivery, Nonverbal Delivery, Content & Organization and Digital Presentation Design.

The survey asked participants for their perceptions of how inclusive the experience was, whether they had engaged in collaborative problem solving, affects on participants' uses of technology on student learning, and how they felt about supporting colleagues with classroom technology use. (See Appendix C for a copy of the Post PLC Participant Survey.) Five out of the six participants completed the survey.

The results illustrated the group's positive feelings about their participation and accomplishments. On a Likert scale of 0 to 5 ranging from strongly disagree and strongly agree respectively, all respondents "strongly agreed" that they had felt included in the

collaborative work and decision making of the PLC. Survey comments about aspects of the PLC that contributed to this feeling included:

Everyone came to the table with an open mind and a willingness to try new things. There was no failure.

Everyone was very welcoming of ideas and asked one another questions, which showed interest in everyone's experiences and knowledge.

The professionalism of the group, as well as the differing skill sets allowed and invited all of us to be successful in different facets of the project.

I already felt comfortable talking with my team knowing we all decided to be here in order to create a tool that can be used to further align our students and staff in the development of technology integration and communication. I thought we all shared our ideas and were flexible when making the scope and sequence for the school.

Similarly, all participants "strongly agreed" that the group had effectively come up with collaborative decisions and solutions. In written comments, all participants' comments pointed to key decisions involved in generating the presentation rubrics by grade level, including starting with fifth grade in order to backwards map competencies, deciding which core competencies to include, and building enough time between PLC meetings to support participants' efforts to try them out with their own students.

In terms of informing their own new uses of technology, participants' ranged from "strongly disagree" to "agree" on rating the statement, "this PLC led me to try new uses of technology." All participants "agreed" or "strongly agreed" that the PLC had led to new teaching practices and included explanations such as, "trying Google Slides on an iPad," "videotaping student tech presentations," and "I tried using the rubric we developed and explicitly taught my students those skills, which I saw huge improvements in." In assessing the impact of their new practices on student learning, all participants

agreed or strongly agreed that participating in the tech PLC impacted their students' learning, adding in survey responses:

It reminded me to try new things and expect success not failure.

Students knew what I was looking for. They reflected on their performance with rubrics and know what improvements to make in the future.

(The rubric) heightens my expectations of (students') communication and tech skills.

Finally, the Post PLC survey asked participants to rate whether the PLC had influenced their feelings of connection to the school and their readiness to support others in using technology. Four out of five participants agreed or strongly agreed that they the PLC had influence their feelings of connection to the school. The answers to the question of whether participants felt "better prepared to support others at our school as a result of participating in this PLC" mirrored the previous question with 40% strong agreeing, 40% agreeing, and 20% neutral. One participant was neutral (rating the response at a 3 on a 5 point Likert scale), explaining that she had began her participation in the tech PLC feeling connected and ready to support others.

Beliefs and practices: Addressing the digital use divide through school-wide focus on real tech skills for students. The concept of bridging the digital use divide was not a universally critical aspect of the work. A discussion at the last PLC meeting about what participants thought about the school's efforts to address the digital use divide and follow up interviews with three participants showed that this concept was not prominent in participants' thinking, at least not in these terms. Giving students communication skills

that would serve them in the modern world, outside of the classroom and beyond their elementary years was important to all group members. The group believed that if they could help to develop signature practices to teach real skills for the real world—site-wide—then the school would become a real Tech school. Their students would be ahead of the game. Tina expressed the feeling this way:

I don't think I went into this process keeping [the digital divide] in the back of my mind, but, um, the reason that I am excited to be exposing our kids to technology and to this presentation rubric, it helps us align across grade levels which ultimately gets our kids ready for future jobs that they would maybe not be ready for if they weren't here having these experiences.

The teachers were motivated to join the tech PLC because they believed that tech skills would be important for their students' futures.

Participants also indicated that providing clear guidelines and support for their colleagues would be a key aspect of building up to “real skills” for their students over the long run of their experiences at the school. As is the case at any school, the skills and confidence to teach with technology are not evenly distributed and need to be supported, considering the diversity of experiences and needs from the perspectives of those who would need to teach it. In a post-PLC interview, Julia, who served as the tech PLC facilitator, described feeling compelled to support her colleagues through the process.

I had the window of staff...of bringing staff on board (in mind) because we have such diverse spheres and abilities and skills. So what I was thinking of the whole time was how to bring other teachers on board to do the technology...who are afraid of technology. Because, quite frankly, it's real life, and you know, (providing) some easy... baby steps can help them, because we can teach them too.

Another participant—Mark, who created a student version of the group’s presentation rubric—emphasized how clear goals and repetition would be important for student ownership of the learning. For equitable access, it would be critical to provide students with multiple opportunities to develop the competencies over time.

Thinking about...like a student that, you know, doesn’t have access. The rubric gives them opportunity for growth, because then they can see the way they’re placed (on the rubric), and then they can see what requirements they need to meet. So, at least it’s something that’s explicit for them. So maybe not this opportunity, but the next opportunity, maybe not this grade, but next grade. So it’s consistent, you know? It’s like, “I have room. I can grow.”

Access to learning “real tech skills” across multiple grade levels through multiple opportunities came up as a recurring theme of discussion as participants created and mapped out the rubrics across grade levels together.

A sense of urgency also influenced the work. While the digital use divide may not have been openly discussed during PLC meetings, it did come up with one of the teachers who had been part of the school’s initial discussions about becoming a tech school three years earlier. During an individual follow up interview, Janine echoed the group’s satisfaction with their PLC work and their desire to ensure that students would receive explicit support and guidance across the school.

I think we accomplished a lot, especially when (sharing student presentations). It was great to have the grade levels talk about it out loud, about our expectations of a good presentation. It’s not all about tech. It’s also about expression, but their message needs to be with technology at this point, especially in the (modern) world. Basically, they’re going to have to present something all the time, and work in groups.

She added her sense of urgency that came from seeing the digital divide in terms of differences in access and use across local communities that she was part of.

I think there's urgency because so many other schools in other areas are already starting with technology. It feels like the gap just gets bigger if we don't introduce our kids to (tech), especially since they didn't have it at home as much before. The parents have gotten smartphones in the last three years—almost everyone now, right? Before that, it was like they didn't even have it at home, so it was like, if we don't introduce it at school, then they really had none. (But) in other places, it's already so integrated. So the urgency came from seeing the gap.

This urgency also fueled her understanding of why the tech PLC's work on supporting explicit instruction was so critical to bridging the gap.

For our school, when we got the iPads, that was a big deal because, for some of (the students), it was their first time just playing with it. You have to explore first, and then think about the instructional part and learning how to teach with it with some kind of progression. I guess I feel much better now. Our school, we've done a great job. It's amazing how much we've accomplished in three years with your focus. I think it's because, in your leadership, you said, "We're going to get it here," and we have such a great team of teachers who are so excited too. So that was a big help for our school, right? Everyone went to the Google, and tried (new practices) too.

While Janine spoke less compared with most of the other PLC participants through the process, she had been an early adopter and driver of the school's vision for technology integration. Janine had served as one of the school's first tech leads, and her quiet way of leading included sending her students to their former teachers to show their tech projects in the hopes of inspiring them to want to learn more, to want support she regularly offered to her colleagues. She had pioneered student productive uses of technology in her second grade classroom—from creating audio books, to using green screens for student created videos, to convincing a local volunteer to come and teach weekly coding classes.

In general, tech PLC members' heightened experience with integrating technology for communication was evident from the beginning. When asked about use of technology in support of the "4 Cs" of 21st century learning: creativity, collaboration, communication, and critical thinking, differences between tech PLC participants' responses and responses from the rest of the staff were sharpest in the area of communication. While only 37.5% of the rest of the staff indicated they were regularly teaching communication with technology across content areas, 66.7% of the tech PLC indicated that they were doing so at the start of the PLC. By the end, 100% of the tech PLC did, perhaps because of the work that they accomplished together.

In terms of how the technology PLC was associated with the teachers' beliefs and practices regarding addressing the digital use divide, the participants' focus on making slide presentation applications accessible to students as tools for communication channeled their collective desire to teach students "real world tech skills" in ways that could pave the way to bridging the digital use divide in their classrooms. By moving beyond creating their own teacher presentations towards teaching students to effectively communicate on topics that involved student choice, this self-selected teacher group used the PLC structure to solve a problem of practice in a way that built student agency with technology. Agency is a key concept in the National Ed Tech Plan (U.S. Department of Education, 2016), especially in terms of learning in modern times:

Learners with agency can intentionally make things happen by their actions, and agency enables people to play a part in their self-development, adaptation and self-renewal with changing times. To build this capacity, learners have the opportunity to make meaningful choices about their learning, and they need practice at doing so effectively. (National Ed Tech Plan, U.S. Department of Education 2016, p. 8)

If learner agency and productive uses of technology to create and communicate are ways to begin to bridge the digital use divide, the tech PLC teachers worked together towards doing so.

Tech PLC teachers explored one another's practices and set concrete goals to align and guide their teaching efforts. Meetings allowed the teachers to coordinate understandings in order to create new tools in support of their negotiated shared vision, tools which they planned to introduce to their colleagues in order to promote school-wide alignment on just one aspect of technology integration—digital presentation. The teachers in the tech PLC started with more experience with using technology to facilitate student communication. They had all attended various outside trainings, yet had not had opportunities to explore new knowledge and practices with one another to design supports for their shared school context. Through the tech PLC, teachers clarified and expanded their teaching of digital presentations beyond their own classrooms. In so doing, they worked towards bridging the digital use divide across their shared context.

When studying high school level teacher collaboration by department, Horn & Little (2010) found that the functions, purposes, timing and tasks that brought groups together informed their interactional routines and what they were able to ultimately accomplish. In the case of this tech PLC, the participants' technology experiences, the time provided, and the purpose that they set to accomplish were critical meso-level factors that informed micro-level PLC interactions among the group members (Horn & Little, 201, p. 185). It is the nature of these routines and interactions that facilitated tech PLC members' innovation and accomplishments.

Participants' "on the ground" knowledge of the needs of their students and colleagues and the opportunity to coordinate efforts with the school's leadership in order to take another step towards becoming a "real tech school" was critical to the tech PLC work. Figure 7 illustrates the mediating relationship between the PLC and the rest of the school. In their discussion of teacher learning communities, Horn and Little (2010) described "meso-level participation routines" that teachers "used to organize major parts of their work together" (p. 211). Borrowing from the author's terminology, Figure 7 builds on the concept of "meso-level" factors by depicting how other school-level factors also determine participation routines (such as working on school-wide rubrics together). These factors include: 1) relations between PLC members, 2) relations between PLC members and other members of the school, 3) relations between PLC members and the school's leadership, and 4) relations between the broader school context and school leadership. Not only did these additional interactions and relationships influence meso-level participation routines, they also point to context factors that contribute to a PLC's potential for distributing leadership across the school, beyond the PLC. Most importantly, meso-level factors played an important role in determining the types of micro-level interactions that occurred in the midst of the professional learning community. These interactions lay at the heart of the tech PLC's genuine teacher collaboration and learning.

RQ #2: What are the Aspects of the PLC that Facilitate Teachers' Innovative Practices Related to Addressing the Digital Use Divide?

The technology PLC, as experienced by the researcher-participant, reflected in post-PLC surveys, and described in individual follow up interviews with three of the teachers,

exhibited characteristics of an effective PLC based on the effective PLC framework synthesized from the literature review of this study. Yet, the work was

Figure 7. A model of the interactions between school leadership, the tech PLC and the school context in jointly developing the school’s vision and goals regarding integrating technology into teaching and learning.

not simple or necessarily easy, and aspects of the group’s accomplishments support Horn & Little’s (2010) finding that “shared dispositions toward improvement may be necessary but not sufficient for collaboration to yield opportunities for professional learning” (p. 212). The tech PLC succeeded in creating professional learning opportunities by negotiating a range of decisions—from deciding what to do with their time together to negotiating the specific terms and meanings that anchored the jointly created rubric,

which spanned five grade levels. Each teacher participant planned and incorporated the rubric into his or her instruction and student use, then the teachers came back together to share and score exemplars on the rubric. What aspects of the PLC facilitated these collaborative decisions and innovative practices?

To further explore this question, this study followed “research that probes ‘inside teacher community’” by “trying to uncover the kinds of distinctive processes that characterize vigorous and effective teacher communities” (Little, 2012, p. 18) as well as studies of “naturally occurring discourse” first applied by Hugh Mehan in the classroom in *Learning Lessons* (1979) and continued in naturalistic studies within educational research aiming to examine the fabric of the “taken-for-granted” social worlds of schools (Macbeth, 2003). Approximately six hours of audio recordings taken from all PLC meetings were transcribed and analyzed for micro-level interactional patterns and potential “conversational routines” (Horn & Little, 2010) that either helped the group “engage in” problems of practice or “move on” from them (Little, 2002, p.930).

Analysis of meeting transcripts began with these studies as a frame of reference. Little (2002) challenged researchers to move beyond designating typologies of strong or weak PLC cultures that had been characteristic of prior research. Instead, the author aimed to address “analytic dilemmas associated with looking closely inside teacher communities” (p. 937) by using a conceptual scheme to “unpack the relations among teacher community, teacher development, and the improvement of practice” (p. 934). Little’s (2002) framework for transcript analysis included looking closely at teachers’ representations of practice, orientations to change, and their norms of interaction, which

she then connected to potential trajectories of individual and group development.

Horn and Little (2010) built on this framework by focusing in on the norms of interaction across teacher groups, identifying conversational routines of one effective group compared to a less effective group in the same building. In doing so, the authors added that the productive micro-level interactional routine “was buttressed by shared frames of reference, shared curriculum, and strong leadership that supported a particular vision of teaching” (Horn & Little, 2010, p. 211).

Using these findings as a framework for initial analysis of the tech PLC interactions, coding was first organized along teacher representations of practice, norms of interaction, and shared frames of reference. These concepts were broken down into “shared resources” as a theme for coding and “productive teacher talk” as another them for coding. Coding analysis was done using MAXQDA12 software and was informed by social constructionist grounded theory (Charmaz, 2014) and case study coding (Creswell, 2013) to look for relevant patterns and associations in the interactions recorded.

The shared resources that tech PLC teachers drew on in their interactions with one another were further categorized based on emerging patterns. These included: 1) their vision for what becoming a technology-focused school entailed, 2) shared experiences through the history and process of building the vision, 3) shared technology skills or competencies, and 4) aligned resources related to using technology in the classroom, and 5) aligned pedagogical beliefs, especially as related to student technology use.

While these shared resources were important and recurring, they also served to “buttress” productive teacher talk, as described by Little (2006) and as occurred across

tech PLC meetings. Productive teacher talk included conversational patterns that helped members to “deprivatize” practices with each other, to find ways to air and explore disagreement and differences, and to dig into problems, towards “acceptance of teacher-to-teacher initiatives on matters of practice” (Little, 2012 p. 17). According to Little (2006), teacher talk characterized by these types of interactions builds teacher communities that are ripe for cultivating teacher leadership.

Interactions that facilitated such “deprivatization” of practices were grouped together as productive “teacher talk” and broken into building blocks informed by Little’s (2006) findings and by interactions found in tech PLC transcripts. The resulting “teacher talk” codes were: 1) transparency of practice, 2) engaging and exploring, and 3) acceptance of group initiatives. These patterns characterized pivotal moments across the tech PLC meetings when members of the group explored teaching practices and when they made collaborative decisions related to teaching students the skills associated with creating and delivering digital presentations. Such productive teacher talk helped tech PLC participants in realizing the four aspects of effective PLCs, which served as a framework of analysis for research question #1 of this study: reflective practice based on student learning, inclusion, collaborative problem solving, and shared leadership. Because of the importance of micro-level, “teacher talk” interactions in facilitating the PLC’s effectiveness, coding and analysis zeroed in on aspects of “teacher talk” and “shared resources” and how they related to each other throughout the natural discourse of the tech PLC. Such analysis sheds light on how these interactional elements and patterns helped to facilitate the tech PLC teachers’ collaborative innovations related to supporting students’

high levels of technology use in their classrooms.

Teacher talk: Building blocks for a productive professional learning community.

The building blocks of effective teacher talk included teacher interactions characterized by “engaging and exploring,” “transparency of practice,” and “acceptance of group initiatives.” Line by line analysis of tech PLC meeting transcripts used these three main codes for “teacher talk” that facilitated collaborative decisions and follow through on those decisions. Coding memos and notes through the process defined “engaging and exploring” as “the ability to engage and explore problems of practice in order to collaboratively problem solve.” This was characterized by questions posed by participants to each other or open exploration of different perspectives—including how to do something, what seemed important for classroom practice, or how to interpret or value particular practices.

Within the context of the tech PLC meetings overall, “engaging and exploring” codes were highly associated with “transparency of practice” codes, as depicted in Figure 8. This was because the “engaging and exploring” interactions often came from teachers asking one another about their use of technology in the classroom, including reflections on how well things worked. Responses and continued discussion often relied on other participants’ willingness to respond by sharing and reflecting on their practices—including successes as well as set backs. It falls to reason that authentic “engaging and exploring,” or deprivatization of practice, would require “transparency of practice” between teachers. The numbers in Figure 8 show counts of these two codes co-occurring within one line of transcribed text. Bigger boxes represent higher instances of

overlapping or adjacent segments. For example, Transparency/trust overlapped with Engaging/Exploring 112 times and with Group Buy-in 5 times for a total of 117.

Code System	Transparency/ Trust	Group Buy-in/ Action	Engaging/ Exploring	SUM
Transparency/ Trust				117
Group Buy-in/ Action				109
Engaging/ Exploring				202
SUM	117	109	202	428

Figure 8. An analysis of all PLC meeting transcripts depicts the number of associations between Teacher Talk elements of Transparency/Trust, Group Buy-in/Action, and Engaging/Exploring. The group's Engaging/Exploring interactions were most highly associated with Transparency/Trust, followed by Group Buy-in/ Action.

Meanwhile, Engaging/Exploring occurred with Group Buy-in/Action 97 times. The total numbers of segments coded under all umbrella codes and sub-codes can be found in Appendix H.

While the association between these building blocks for productive “teacher talk” seem logical, they did not always occur naturally or easily. As an example, one instance of Transparency of Practice occurred during a critical discussion while deciding the range and meaning of the numerical scale of the rubric that the group was creating as they were getting started on the release day. To provide context of the discussion, most of the teachers in the group were vocally criticizing district definitions of report card numeric scales which range from scores of 1 to 5, from below proficiency, to approaching proficiency, to basic proficiency, to proficient, to advanced proficiency. The focus of the criticism arose from recent conversations in district steering committees, which had identified “advanced proficiency,” as based on classroom instruction, not on outside knowledge or skills that students brought to their work. Two teachers were surprised by this news and three more were critical of the guidelines because it seemed to preclude

identification of the “truly advanced.” In the midst of the teacher talk, Mark’s comment that he “kind of” agreed with the district guideline happened at the same moment Amy expressed unequivocal disagreement (overlapping statements are delineated by brackets in transcription excerpts), and Mark almost went unheard.

Julia: ...so we have three ons; we have really on, mostly on, and sometimes on, every other day on. (Laughs) Is that what we have?

GROUP: [laughing]

Amy: [sort of on]

Janine: So, advanced-nobody's advanced, ever. No, don't give them that.

Julia: ...That's what I'm hearing you people say.

Mark: (almost inaudible) [I kind of agree] with them.

Amy: [That's why I totally] disagree with it.

Sara: [That's what]...that's what they were telling us.

On an invitation from Tina (“Wow, did you know that?”), the principal-researcher joined the conversation to provide some explanation of the rationale behind the discussions, making room for Mark to participate more transparently with signals of agreement.

Pam: I'm being asked this question right, so I'm going to clarify my understanding (Laughs) that advanced...it wouldn't be fair to put advanced for something you didn't actually teach them.

Mark: Right.

Pam: So if you ... If you're exposing them, and some of them actually got it. That's fair game for advanced. But that it's not something that they just did on their own without anyone teaching them.

Mark: Mm hmm.

The group proceeded to engage in a discussion and debate about the fairness of

grading students based on their outside experiences, bringing up specific students and situations as examples for discussion, and eventually (about four minutes later) came back to their work on the rubric, viewing its creation as a way of making learning explicit and allowing students to excel into an “advanced” scoring on the rubric, in alignment with district definitions.

Sara: ...but I understand that's not fair to be trying to grade kids on stuff we haven't taught.

Tina: ...totally.

Mark: ...right.

Tina: That, [that doesn't make] sense.

Mark: [Cause that's not a reflection of...] what's happening in the classroom.

Sara:no

Tina: No.

Sara: No, but we're thinking how can we show kids that you noticed their ...extra efforts

Mark: By having rubrics, because there's not enough rubrics throughout.

Sara: ...yeah, there isn't.

Tina: Like, for example, so if we're asking them to add multi media into their presentation. Whether it's video, pictures, whatever, depending on the grade level. And we say if you do the requirement, you do one. You have to have one thing put in. But then you have a kid who did four. And they did it well.

Mark: Mm hmm.

Tina: So like we need to be thinking about those kinds of things as we make the rubric... right, as the rubric progresses. Three should be like my expectation, and then the four and the five should be like, them applying

it, and doing it ...

Mark: In a meaningful way?

Tina: Yeah. Does that make sense? Is that like where our brains should be when we're doing this?

Mark: I think so.

Tina: Okay.

While the underlying disagreement may not have ended in agreement, the group was able to turn back to the work of making the rubric, informed by the conversation. Several teachers would later share the rubric with their students in order to support extra efforts to reach “advanced” levels, and Mark would make and share a student friendly rubric for this purpose. In an individual interview after the PLC meetings concluded, Mark revisited this moment of transparency. Although he acknowledged that the views expressed during the exchange remained “unresolved” he reaffirmed his feeling of trust with the group based on the relationships and reputations of each member coming into the PLC.

I didn't think about it too much just because the people in the room, I'm so comfortable with. It's like our Parkview family. If we can't have real conversations about education, then what can we talk about? So I'm okay with us having those uncomfortable... and it didn't feel uncomfortable. It just felt like we had sides. Then when we were finished talking because Amy had to leave (to teach an intervention class), then it was okay; we just move on. It didn't have any lingering effects. I didn't feel weird afterwards like sometimes you do when you have challenging conversations. I think we came in with an inherent trust and I think there's a lot to say about reputation. I don't work with Julia but I know her by reputation and I respect her. The same goes for Janine. Then I know Sara, Tina, and Amy personally. I think we came in knowing that this was a serious group. It was a group that volunteered and it was a group that wanted to be there. I think that made the difference.

These excerpts from the PLC release day and interview illustrate one instance of “transparency of practice” with teachers “engaging and exploring” different views. These elements of teacher talk were critical in moving the group forward on decisions and actions, making the tech PLC’s accomplishments possible.

Over the course of the PLC meetings, in alignment with the different focus and goal for each meeting, different elements of “teacher talk” came to the forefront in frequency and significance, but all three elements were necessary for accomplishing the PLC group’s purpose within the timeframe. Figure 9 provides an overview of these teacher talk elements across the different PLC meetings, alongside coded interactions for “affirmation invitations.”

“Affirmation invitation” interactions included sub categories of “bids” defined as specific comments or questions that bring other participants into the conversation, “laugh,” and “agreement.” Laughter and agreement coding was done using a blend of lexical searching and hand coding of all PLC meeting transcripts. These small but significant utterances occurred alongside the most productive segments of meeting transcripts. They seemed to facilitate participants’ collaboration by inviting quieter voices to join in the conversation, by lightening the mood at times, and by signaling agreement or encouragement as colleagues engaged in sharing individual perspectives or practices.

The varying levels of different teacher talk elements across PLC meetings highlight the importance of the group’s “exploring and engaging” when determining their PLC goal and in the midst of the release day as they worked to

map out a shared Presentation Rubric across competencies and grade levels.

Figure 9. Analysis of Teacher Talk over the course of the PLC meetings highlight frequencies of the three elements that contribute to building a learning community (Transparency/Trust, Group Buy-in/Action and Engaging/Exploring) in association with the purposes of each meeting.

When the time came to share videos of students actually presenting based on the group members' teaching, the third PLC meeting required more "transparency and trust" while teachers explored how to score students' work, and discussed next steps that could be taken to augment students' skills. Finally, at the last PLC meeting, the conversation turned to how the tech PLC work could support school-wide practices. This last meeting included engaging/exploring talk, but decisions about group actions necessitated teacher talk focused more on "group buy-in and action" needed for "acceptance of teacher-to-teacher initiatives on matters of practice" (Little, 2012, p. 17). Involving group agreed

upon actions was a particularly important aspect of closure for this tech PLC, given the group's original purpose of affecting technology implementation across the site.

Shared resources: Foundations for productive teacher talk. When accounting for differences across teacher communities' collaborative interactions, Horn and Little (2010) highlighted the importance of "shared frames of reference." These frames included participants' goals for the work, related ideas, terminology and professional development, all of which informed how teacher groups approached problems of practice. Shared frames of reference, including common curriculum and leadership, seemed foundational for productive teacher talk. "In the absence of a collective frame of reference, individual perspectives and preferences prevailed, especially when disagreements surfaced" (Horn & Little, 2010, p. 209). Without shared frames of reference, collaboration disintegrated into individual preferences.

If common curriculum and training often serve as shared frames of reference for teacher collaboration, a technology-focused PLC faces unique challenges in these areas. Widespread professional development on teaching with technology has not been as ubiquitous for as long as traditional content area associations and conferences. The first Google Apps for Education (GAFE) summits only became more widespread in 2012, and there is no published curriculum for embedding technology into teaching. Yet the tech PLC members did draw from shared frames of reference, such as insights gained from attendance at local GAFE summits, which were sponsored by the school over the previous three summers. In fact, many of the ideas and resources shared with the tech PLC, which were central to the presentation rubric building, came from two of the

participants' attendance at a GAFE workshop on digital presentations the summer before the tech PLC.

The evolving purposes of the different PLC meetings were differentially associated with different types of shared resources. Just as different meeting purposes had been associated with different elements of teacher talk, teachers drew from different “shared resources” depending on the kind of collaboration they engaged in—sharing practices, engaging or exploring perspectives, or moving towards group decisions. Associations between shared resources and teacher talk elements provide information about the types of shared resources that facilitated different kinds of collaborative work.

Coding for shared resources identified five different categories that emerged: “aligned resources” (media that members could all reference or follow), “technology skills,” “shared contexts and experiences” and “student-centered pedagogy.” Figure 10 shows counts of the various types of “shared resources” occurring within one line of each of the three elements of productive teacher talk: transparency/trust, group buy or action, and engaging/exploring. Teacher talk elements define the columns and the shared resources inform the rows. The shared resources and how they were identified and coded are described below in order of prevalence within the transcripts.

Shared resource: Shared context experiences. While it wasn't until the final PLC meeting that “shared context experiences” coincided most with one of the elements of productive teacher talk (“group buy-in and actions”), “shared context experiences” was the most frequently coded shared resource across all PLC transcripts. Interactions reflecting shared context experiences included participants' shared experiences and

understandings from their day-to-day interactions over the time that they had been a part of the shared school context.

Meetings	Code System	Transparency/ Trust	Group Buy-in/ Action	Engaging/ Exploring	SUM
PLC 1: Review of Staff Survey Data, Goal Setting	Tech skills or experience				0
	Shared Context/ Experiences		•		2
	Shared Vision				0
	Aligned Resources			■	7
	Student centered pedagogy				0
	SUM	0	2	7	9
PLC 2: Release Day Rubric Development and Planning	Code System	Transparency/ Trust	Group Buy-in/ Action	Engaging/ Exploring	SUM
	Tech skills or experience	■	•	■	87
	Shared Context/ Experiences	■	•	■	84
	Shared Vision	■	■	■	76
	Aligned Resources	•	■	■	123
	Student centered pedagogy	•	•	■	48
	SUM	56	79	283	418
PLC 3: Sharing Student Projects for Rubric Calibration	Code System	Transparency/ Trust	Group Buy-in/ Action	Engaging/ Exploring	SUM
	Tech skills or experience	■		■	12
	Shared Context/ Experiences	•			2
	Shared Vision		•		2
	Aligned Resources	•			2
	Student centered pedagogy			•	2
	SUM	12	2	6	20
PLC 4: Closure and Next Steps	Code System	Transparency/ Trust	Group Buy-in/ Action	Engaging/ Exploring	SUM
	Tech skills or experience		•		4
	Shared Context/ Experiences		■	■	43
	Shared Vision	•	■		13
	Aligned Resources				0
	Student centered pedagogy		•		5
	SUM	3	46	16	65

Figure 10. Shared Resources for Teacher Talk over the course of PLC meetings. These frequency counts highlight occurrences of productive teacher talk codes that overlap or fall within one line of shared resources codes in association with the purposes of each tech PLC meeting.

These experiences ranged in variety from attending summer technology training(s) such as GAFE together, to previous experiences volunteering on the site's technology steering committees, to shared report cards, school initiatives, and interactions with common colleagues at the site.

“Shared context experiences” also included referenced understandings about: the school's culture, student backgrounds or needs (at the site), specific students, calendar or time demands on the staff, previous conversations about what was needed to become a

tech school, the technical support needs of staff members, the various strengths of staff members, and understandings about the school context such as grade level dynamics and pedagogical leanings. These shared context experiences, and the goal of moving the school forward as a tech school, were what led the teachers to participate in the tech PLC in the first place. The importance of having the time and space for such collaboration and tailoring of resources and supports to the site was expressed by Janine in a post PLC survey written comment (with original emphasis), “This PLC is so important for us to develop the REAL PRACTICES of a TECH school.”

Shared resource: Aligned resource. Sequences coded as “aligned resource” described interactions referring to materials shared with the group or talk centered around trying to align materials to the uses or perspectives of multiple participants. These codes occurred the most in transcripts of the first and second PLC meetings. Because the first meeting focused on examining staff survey data on the technology context of the school, interactions were facilitated by the data, of which each participant had a copy. References to and discussions of data included in this “aligned resource” were coded as such. The second PLC meeting, which was the release day during which participants built the presentation rubric, also relied heavily on the group’s ability to reference shared materials to make decisions about the rubric—from the numerical scores, to the broad categories, to the specific wording in the categories and how they progressed across scores and grade levels. On this day, teachers came with resources that they had gathered from previous technology conferences or from Internet searches related to digital slide presentations, presenting, speaking, and writing. While print resources were made available with hard

copies, the resources that became most commonly referenced were digital resources that individual participants could share with each other by uploading to a digitally shared folder accessible to all.

Shared resource: Technology skills. Coding for this category of shared resource included references to technology skills learned from workshops, interactions involving application of technology skills in the midst of tech PLC interactions, and references to teachers' experiences using specific technology applications with students. Technology skills codes occurred the most during the PLC planning day and the third meeting when teachers came together to share their students' recorded digital presentations.

Though there was little explicit discussion of the teachers' own technology use through the tech PLC meetings, group members' familiarity and facility with shared productivity tools such as Google Drive, Docs, Calendar, Slides, and Apple TV allowed participants to find and share resources electronically with each other as well as to project and edit the documents by and on which the rubric was collaboratively constructed. With these shared tech skills, participants were able to virtually "share" and refer to specific documents, others could find and reference those same documents, and the group could explore and engage one another's ideas in real time, as they collaboratively worked on the document. Such incidental, yet important discussions included topics ranging from which skills to include on the rubric, to clarifying the meanings of specific words used in other rubrics and deciding whether or not to adopt them. Shared "tech skills" were most prevalent during the planning day as teachers organized, shared and created resources. Technology skills were also relevant when the tech PLC's explored each others'

experiences with teaching presentations across different applications and grade levels.

This second aspect of referring to technology skills as a shared resource helped to guide the group in creating a presentation rubric that would be specific enough to provide guidance for explicit teaching, yet broad enough to apply across a variety of digital applications. The PLC rubric creation process included many conversations about related, yet different, technology uses across the classrooms and grade levels represented within the tech PLC group. Such conversations exposed technical difficulties or areas of expertise available for support. They also gave participants a better sense of what shared resources they had access to in terms of technology skills and expertise at the site. As an example, the following excerpt illustrates teachers sharing “tech skills or experience.”

Janine: Have you guys try to use ... did you use the Adobe Voice, yet?

Tina: Um, I have my kids only use it for like, um when they're done with their literature circle. And they [do it as like a project], yeah.

Janine: [You used it this year?] You haven't had any problems getting on?

Tina: M mm (negative)

Julia: I didn't use Adobe Voice last year.

Janine: It was just all on the website. Half the projects... I just had to let them not finish, because the site was not letting them on. And it was so frustrating getting on.

Tina: Really? This year?

Janine: Yeah, 'cause everything changed, so that all of the things are (now) online. It used to be that if it's your project, it's stuck to the iPad, but they changed it to online, so you can access it from anywhere. The idea is great, but then every time you turn it on to get on, the loading process was so long, that they, most of them ... every time we made time, we were just sitting there waiting for their projects to load onto their machines. So, you didn't have that problem?

Tina: No, um...

Janine: So when you go on and your class projects are all on your ...

Tina: I'm pretty sure. They do it a lot. They just do it independently; I just show them how to log in.

Janine: They haven't complained about it loading?

Tina: ...and they presented them and everything. But I can play with it too, because they may be seeing something that I'm not aware of.

Both the nature and the focus of the tech PLC's work made sharing technology skills an important aspect of the group's collaboration and ongoing support of one another.

Shared resource: Shared vision. Interactions coded as referencing “shared vision” reflected participant interactions in their attempts to align their vision and practices for student technology use within the context of the site. All participants expressed a strong desire to support students' real and relevant technology skills as a motivating factor for their participation in the tech PLC. Yet the vision of what these skills were lacked focus and clarity from the very first meeting. From the first discussion around what a digital presentation really referred to, to the various backgrounds, experiences and thinking of the participants themselves, moving towards a shared vision of technology integration was one of the most challenging aspects of supporting innovation at the site level. For example, in an individual interview with Julia after the PLC meetings, the elected facilitator of the PLC talked about how her own transition from industry to education revealed to her the slower pace of technological change in education, her understanding of why, and the desire to help others get over their fears of “pushing the button.” Yet with technology changing at such a fast pace, teachers need to “use it or lose it,” which was

why the team's work to support technology integration in explicit ways seemed valuable.

So, a few years ago I was choosing a Masters program, and I looked at the offerings that were all around this local area, and the only thing that interested me that I thought was a hole in my professional toolbox, was the tech. So I started my Masters program in Education Technology at Santa Clara.

(This was probably also) because I also started in the business world; I had been on the cutting edge of spreadsheets and word processing when it was out there. So I already had the basic (skills) and I wasn't afraid of technology. I don't have any fear of that. My mentor at the time was sending me to all these classes to learn spreadsheets and other (programs), and he said, "Don't be afraid to push a button." He told me a story of how he was a Lieutenant Commander in the Navy, and his job had been the entire naval payroll. He said one time he was doing the naval payroll, and he (messed) it up, and the entire Navy didn't get paid because of one thing that he did. So he said, "Nothing you can do is ever going to be worse than that. So push the button."

(Then) I left industry and went to education. I noticed differences. It wasn't a thing in the beginning when I was first working. But then, you know how fast it changes, and we don't change that fast. We cannot...well some can, but as a culture, we don't change that fast, and it's fast. And so my Silicon Valley friends would be having conversations and I didn't understand what they were saying, and I couldn't contribute to them and that pissed me off. So that's why I enrolled in the master's program.

But, you know, it's kind of like anything else. Unless you use it, you lose it. And so, you know, I'm not doing the program anymore and it just...changes. Six months later, it's all different. And so I like to be the best at what I do, so I always go to the CUE (Computer Using Educators) conference, so I joined the organization. I'm pretty proud of what we have accomplished, I hope you are proud of what we accomplished too.

Julia's sentiment of feeling proud of the group's work was broadly reflected in the post PLC surveys. All of the teachers "strongly agreed" that the group had come up with good plans, that they felt included in the collaborative work, and that they had been part of the decision making in the PLC. Such sentiments may reflect the group's feeling of progress towards clarifying one aspect of their shared vision, and their ability to support the school

in taking a step towards it.

Shared resource: Student-centered pedagogy. Within the interactions of this tech PLC, the “student-centered pedagogy” code reflected group references to student agency—providing choice, or helping develop students’ voice in their production and communication of media. These coded sections included participant discussions about students having some choice in their selection of topic or elements to include in their presentations, sharing evaluation criteria with students and facilitating student-to-student support or technology leadership roles in the classroom or across the school. They also included participants’ discussions about technology uses that students might or did perceive as motivating or engaging. As members of a school that had been identified for “program improvement” under *No Child Left Behind*, the teachers found the discussions on mastery versus proficiency refreshing and appealing. Yet all were aware that student achievement as measured by state assessments still needed to inform and drive their efforts. One of the most positive participants of the tech PLC highlighted the difference in this sense of student centeredness in comparison to work in grade level PLCs, which always focused on monitoring student progress towards proficiency. Sara compared the motivations and impacts of each model, building on Mark’s similar feelings during a PLC member-checking discussion at the start of the third meeting.

I was about to say the same thing as Mark. So grade level PLC's obviously force me to focus on something very specific. (They) help me identify kids that are struggling. So I see the benefits but it also makes me see that kid as that number where he's the one with the X. So I need to push (laughing) because then if my data is horrible when I come back, I'm going to be like "Oh my gosh." I'm going to feel like a horrible teacher. I didn't do anything. These kids are slipping.

So I mean I see why that accountability is necessary for some teachers to push them, but at the same time, I enjoy this PLC way more. This is one where everyone is going to try this! They're going to practice this presentation style, and I was excited about it. I could see the potential in all of the student's doing well, because I wasn't looking at them going "Oh he's the one (who is struggling). Oh he doesn't have an X, so he's fine; just let him be at the lower end because I didn't put him as a potential (student to target in order) to push my percentage up." I mean they're both beneficial. It's just, this was a lot more enjoyable for me because I got to choose a topic and when to do it. With (grade level) PLCs it's like, "Put your data in next week or else we're going to get in trouble!" (laughing)

Giles and Hargreaves (2006) warned that narrow, standardized measures of achievement threatened to “micromanage the process of learning to such a degree that there is little scope for teachers to learn in what little time is left over” (p. 153), especially in schools and districts serving poorer families compared with “more affluent communities where schools meet measured standards and enjoy the freedom to explore beyond them” (p. 189). For the researcher–principal, these candid comparisons of the tech PLC with grade level PLCs she had helped to put into place at the school provided thought-provoking feedback. The teachers’ comments provided concrete reminders to consider the unintended effects of progress monitoring practices and to remember the importance of balancing the dual roles of management and instructional leadership.

Affirmations and invitations associated with sharing resources and teacher talk.

Through the process of coding these elements of “shared resources” and “productive teacher talk” two additional codes evolved. They were both found sprinkled throughout all the transcripts, and especially around moments of open exploration of practices by the group or in the midst of important clarifications and group decisions.

The two additional codes included one interaction that has already been introduced

earlier in this chapter as “crosstalk.” Crosstalk described when multiple voices were speaking at once. Crosstalk often happened across multiple turns and involved different combinations of speakers. The second code was a broader one that included a number of utterings or comments, which were grouped as “Affirmation Invitations” and were found throughout the transcripts. Like “crosstalk,” “affirmations” and “invitations” were found especially in sections when teachers were openly sharing practices, dilemmas, or in the midst of airing differences of opinion. Figure 11 shows the relationship between these two code categories and the essential elements of teacher interaction described in this chapter.

The Affirmation/ Invitation code seemed to function as both a catalyst and energy source for participants to engage and explore shared resources and various perspectives or practices. Affirmation/Invitation started out as separate codes for affirmation, laughter, agreement, and bids or specific invitations from one participant to another to share of his or her practice or perspective. Later, they were collapsed into one group and occurred 1,873 times throughout the transcripts of recordings. Affirmations and agreement were most common and consisted of common utterances such as, “mm hmm,” “yeah,” followed by codes of “agreement” which ranged from one word responses such as, “absolutely” to short sentences such as “I completely agree.” Laughter was the next most common code, followed by direct bids or invitations to share.

Although all participants offered some form of affirmation or invitation at every meeting, two participants—Tina and Sara—consistently contributed the highest numbers of affirmations and invitations. While Tina and Sara also consistently participated the

most across PLC meetings, the invitations and affirmations they added seemed to help to bring quieter voices into the group interactions.

Code System	Crosstalk	Affirmation Invitation	Bid	Laugh	agreement	SUM
Tech skills or experient	■	■	■	■	■	290
Shared Context/ Experi	■	■	■	■	■	460
Shared Vision	■	■	■	■	■	253
Aligned Resources	■	■	■	■	■	317
Student centered peda	■	■	■	■	■	98
Transparency/ Trust	■	■	■	■	■	426
Group Buy-in/ Action	■	■	■	■	■	509
Engaging/ Exploring	■	■	■	■	■	1549
Outside Community	■	■	■	■	■	178
SUM	1132	1873	201	349	525	4080

Figure 11. An analysis of overlapping or adjacent occurrences of crosstalk and all sub-codes related to affirmations and invitations alongside other codes highlight the strongest associations among affirmations, invitations, crosstalk, and engaging/exploring teacher talk. Crosstalk and affirmation invitations were also associated with all codes related to teachers sharing resources or engaging in elements of productive teacher talk.

Changes in individual participation as measured by number of utterances through the course of the PLC provide some evidence of the quieter voices becoming less quiet over time. Figure 12 shows the number of utterances coded for each participant in at the first hour of the first tech PLC meeting compared with the number of utterances in the sixth hour, during the afternoon of the PLC release day. Most of the participants spoke more over time, and the three who spoke the least in the first hour were among those who showed the highest ratios of increased participation.

Figure 12. Participants' interaction counts in the first hour of tech PLC meetings compared with the sixth hour after a half day of collaborative planning.

As an example of how invitations and affirmations contributed to group problem solving, an important cross-content aspect of the rubric came about because a couple of the tech PLC participants sensed one participant's hesitation at the first meeting and, through a number of invitations and affirmations, encouraged her to share her thoughts so that the group could problem solve the commitments they were all making to use the rubric in classroom instruction. The excerpt of this key interchange below started with both Sara and Julia noting Tina's uncharacteristic silence in mid sentence, then inviting her to say more.

Tina: So what if ... (Laughing). (Silence)

Sara: You guys were doing something else though, right?

Julia: This is a safe place.

The next segment captured Tina's stream of consciousness talk as she navigated her dilemma; she would not be able to align her use of the rubric with the writing unit like all the other participants had planned to do because her grade level team had already planned something else. She began to wonder out loud if she could embed the project into science instead. The responses from others were immediate and overlapping as four colleagues (including Paul, the district technology coach, who attended the first and third Tech PLC meetings) jumped in with reassurances and affirmations. These affirmations happened quickly and simultaneously with the group's processing of information, resulting in a high number of "crosstalk" codes throughout the exchange. Brackets highlight sections of overlapping talk.

Tina: No, we are moving onto informational writing, but we're going to be teaching ... I need to talk to [the grade level PLC lead]. Okay...(pause) we are going to be teaching biomes as well. Usually when we do informational writing, we do—you know—traditional publishing. But, what if...we did a presentation on an animal to go with science (instead of) writing? Does [that matter?]

Paul: [It's still informational.] Yeah, that's totally informational, yeah.

Sara: [As long as it's a ...still a] presentation.

Tina: [Okay]. Okay, but it's ...

Pam: Eventually you would want your rubric, you would want people to be able to use is across the [content areas.]

Sara: [Right]

Paul: [Yeah]

Julia: Informational, it doesn't matter the [content.]

Sara: [It should be] based on just, “Is it a good presentation?”

Tina: Okay. Okay.

This group problem solving and collaborative decision to support easy integration of the project later became a strength of the rubrics because it allowed the rubrics to be broadly applicable across content areas while offering explicit teaching points for social elements of presenting and the related technology skills.

In this tech PLC’s interactions, the shared resources and elements of productive teacher talk were foundations for mutual support, springboards for further exploration, and helped to facilitate the group’s overall collaboration and accomplishments. Through inclusive interactions, with invitations and affirmations, the group was able to move back and forth between shared resources and productive teacher talk to align goals and practices to help their school develop practices to help bridge the digital use divide.

From meso-level to micro-level interactions on the way to aligning practices.

In all teacher groups we observed, there existed what we characterize as an endemic tension between ‘figuring things out’ and ‘getting things done’ (Horn & Little, 2010, p.208).

At the first tech PLC meeting, members requested a change from a half-day of planning time to a full day. Given the unknown scope of the work they had decided to do, the researcher was in an administrative position to make the adjustment. For school leaders, it is important to recognize the critical elements of time and deadline. Horn and Little (2010) found that the urgency of teachers’ need for shared resources was one of the key elements that prevented some groups from being able to engage and explore problems in order to deepen practice. Setting a goal to create or produce instructional materials can be

a collaborative—and creative—undertaking, but not for tomorrow or next week. The tech PLC in this study, and the flexibility of a full day, allowed its participants time to work alongside each other long enough to engage in exploratory and informative incidental conversations in the midst of the thinking and the work.

Figure 13 shows how aspects of micro-level interactions interacted with meso-level purposes and goals that brought the group together in the first place.

Figure 13. A framework of the relationship between a community of practitioners’ shared resources and three types of teacher talk that support effective professional learning communities. Invitations and affirmations between members help connect shared resources to teacher talk that opens up and explores problems of practice.

The excerpt on pages 135-137 of this text highlights an example of engaging and exploring different perspectives and serves as to illustrate how different strands of

conversation might emerge, change, and return in the midst of ongoing discussion over time. Although the discussion about “advanced proficiency” changed focus and returned to the rubric before closure was reached, Mark later came back to it by building a student-friendly rubric to teach his students in their support of one another, thereby taking a step towards addressing the group’s concerns about allowing students to gain recognition for going “above and beyond” while also attending to his concern that advanced proficiency scores come from guidance and opportunities offered at school rather than from home opportunities which may exist in some homes but not others.

In creative processes, discussion, thinking and insights often happened non-sequentially, with gaps of time in between. In their work with teachers exploring complex science concepts for innovative, hands-on teaching, Bamburger and Mumby (1991) described this messy process of “conversational drift” within group discussions. “Conversational drift” includes the potential for topics or questions to fade then re-emerge later to develop into new understandings. Bamburger and Mumby called this phenomenon “conceptual chaining” (p. 45), and the full day release made room for instances of conceptual chaining, including potentially planting a seed for student-friendly rubrics, resolving a chrome book payment issue, and sparking ideas about how to motivate teachers and students to engage in the school’s technology projects.

RQ #3: What are the Interactions Between School-based Context Factors and Teacher Collaboration and Learning in the PLC?

Part of what made the level of collaboration exhibited in the tech PLC possible were the shared contexts, technology skills, and shared vision of becoming a tech school held by the participants. All had attended technology trainings, most with at least one of their

colleagues. Most had also been a part of original conversations envisioning the school as a tech school. All believed this vision to be a worthwhile goal.

In the broader context of the district's three-year technology initiative aiming at achieving one-to-one digital devices in all schools by 2017 (SSD LCAP, 2014), the participants' roles at the site had developed gradually over this time, starting with visiting exemplar schools for technology integration and providing guidance to the school leadership about how to spend the yearly budgets linked to the one-to-one initiative. In the two years prior to the study, a teacher group, which included five of the six tech PLC participants in this study, had provided input on spending as well as on the training and other supports needed to help the staff actually use the technology purchased. Input on spending decisions included prioritizing technology investment directly into classrooms rather than in labs, finding creative ways (such as foregoing storage solutions in the shorter run) to move directly to 1:2 ratios, and enlisting partners such as the school's PTA and local corporations to help the school move to 1:1 ratios more quickly.

The tech PLC participants had been an integral part of the larger school context and its long-term goals, three years in the making. The work accomplished in the time allotted to the tech PLC illustrates both the potential and the limits of engaging in collaborative, systemic change. Changes involving technology integration are vast in their potential directions. While experimentation on individual levels may develop individual capacities, developing site-wide capacity only happens in focused, incremental ways. And it remains uncertain whether teacher efforts alone are enough to sustain tech innovations. In an interview with Mark, who had come from another specialized school program in the

district, he alluded to that school's eventual hiring of a specific program coach, and related it to tech PLC participants' desire for something similar.

I think it was a few meetings ago where tech PLC members expressed that we need somebody full time, where this is their job, not like a district technology coach that (only) comes periodically...

It's not just tech, but we have the design lab, and want to open it up for STEM projects, with technology being the encompassing thing that (the coach) would be working on: how to implement it within the classroom, pushing (teachers to try new practices). For example, (the other school's program coach) had her own room. We went to her room once a week and she either demonstrated a project for you or, if you told her what materials you needed beforehand, your whole grade level went and you did that project and she supported you.

As Mark pointed out, PLCs can provide time and space to affect change. However, a PLC alone, without investment in a school's technology context and its ecosystem of supports, would likely not be enough to move an organization forward through sustainable, site-wide change.

This study highlighted the complexities of achieving technology innovation and the need for alignment across different aspects of the school context as depicted on p. 51 in Figure 4 "School Context for Technology Innovation." By focusing a PLC on technology innovation, and by using the technology context framework to build organizational supports over time, the tech PLC was able to draw from the school context as a meso-level structure conducive to effective micro-level interactions. Analysis of PLC interactions revealed that alignment across the school context not only provided important shared resources for productive teacher talk, it facilitated the PLC's ambitious goals of building organizational capacity to support systemic innovation: innovation with the promise of bridging the digital use divide, with real world skills, beyond the PLC.

Chapter Five

Discussion, Applications, and Recommendations

Introduction

This descriptive case study set out to describe and better understand how a technology PLC, located within a school and focused on integrating technology to bridge the digital divide, affected teachers' beliefs and practices. In the fall of 2016, six participants volunteered to participate in a technology PLC: five classroom teachers and one instructional coach. Three of the participants were serving as the site's tech leads. An instructional coach and two remaining teachers had been a part of the school's initial discussions about becoming a tech school starting in 2013. The technology PLC met for a total of ten hours over four meetings, including one release day (about six hours) for planning. The first meeting set the PLC goal and was followed by a planning day. After four weeks of instruction using the tools they had created, the group met again to share student work and to discuss how the rubric had supported student learning. Two weeks later, the last meeting in the cycle allowed group members to reflect on the PLC process, outcomes and to plan next steps.

Summary of Findings

This descriptive case study set out to answer three questions. In order to answer the first, "How is participation in a technology PLC associated with teacher beliefs and practices related to addressing the digital use divide?" this study would have had to focus on dissecting and addressing students' classroom technology use and how the PLC closed the gap between passive and productive use before and afterwards. However, since the

tech PLC set out to better define one type of active use of technology for every student in each class, it did not directly study the digital use divide. Instead, analysis of post PLC survey responses showed that the familiar structure of making time and space to set a goal based on the school's teacher tech integration data had positive influences on participants' beliefs and practices in relation to integrating instructional technology in new ways. Positive results of the PLC were associated with participant indications of feeling included, evidence of collaborative problem solving, new classroom practices that culminated in the sharing of student exemplars, and participants' indication of increased confidence in their ability to support their colleagues in technology integration based on the group's work.

The second research question, "What are the aspects of the PLC that facilitate teachers' innovative practices related to addressing the digital use divide?" was addressed through micro-level interactional analysis of participant discussions over the course of the tech PLC meetings. The analysis identified three building blocks for productive teacher talk: engaging and exploring, transparency of practice, and acceptance of group initiatives. These elements were in turn scaffolded by teachers' access to shared resources, or shared frames of reference, which helped them to align their goals and practices. Shared resources included shared contexts and experiences, technology skills, aligned resources, shared vision and student-centered pedagogy. In addition, small gestures of invitation and affirmation were associated with productive teacher talk, especially in instances of engaging and exploring differences of perspective and practice.

Finally, the third research question asked, "What are the interactions between school-

based context factors and teacher collaboration and learning in the PLC?” My participation, teachers’ familiarity with the PLC structure at the site level, and their three-year accumulation of shared contexts and experiences aimed at integrating technology allowed tech PLC participants to draw from shared contexts to facilitate collaboration and learning. The alignment between the PLC goals and the school’s vision for technology integration helped them to collectively work towards addressing the needs of the broader school context to help bridge the digital use divide.

Consistent with presented research, this study supported findings that Professional Learning Communities (PLCs) hold some promise for developing a school’s capacity to evolve with changing contexts and needs (DuFour, 2007; Little, 2012). By examining a tech PLC’s work to help its school begin to bridge the digital use divide, this study captured and analyzed six teachers’ interactions while in the midst of addressing a problem of practice that is emerging as a major equity issue in the 21st century. “Without thoughtful intervention and attention to the way technology is used for learning, the digital use divide could grow even as access to technology in schools increases” (p. 21, NETP 2016). Interactional analysis of meeting transcripts captured the importance of alignment between school leadership, school context, and the tech PLC’s goals and purposes in facilitating productive collaboration and results. Alignment across the school’s technology innovation conditions and PLC contexts also enhanced participants’ capacity for distributed leadership beyond the PLC.

The unique methodology of this study included my perspective as the researcher and principal who conducted it. Procedural safeguards put into place to mitigate researcher

positionality, subjectivity, and limitations of self report may have also laid the groundwork for incidental learning, not originally planned into the study, yet relevant for practicing educational leaders. Meanwhile the application of several frameworks of analysis allowed for meso and micro levels of analysis, which included relevant insider understandings about the context up to five years prior to the study.

Resulting findings about the important influences and relationships among meso-level organizational factors and micro-level interactions illustrated how the purposes designated for time spent together, the people involved, and the relationships between all three set the stage for what is possible for the group to accomplish in the time allotted. Conversations and actions captured in this case study highlighted some of the challenges of technology innovation at the site level and supported research previously presented on important conditions for technology implementation (Zhao et al., 2002; Wong et al., 2008). Using technology innovation and effective PLC frameworks to analyze the tech PLC's interactions illustrated how building up shared experiences, resources and practices supported teachers' abilities to bridge the digital use divide. Implementing new technology uses—related to student presentations in particular—required leveraging multiple context factors in alignment with goals for the site's technology integration.

The resulting work of the tech PLC in this study illustrated the level of focus and the types of interactions that were involved with achieving one small increment of change. The interactions also illustrated how a technology PLC capitalized on teachers' context-specific understandings to help participants to coordinate their efforts towards cumulative change. These important aspects of the teachers' shared resources, or shared frames of

reference, came through the accumulation of multiple shared experiences among PLC participants, and through the accumulation of shared interactions between PLC participants and the site's teachers, leadership, and technological infrastructure.

Implications for Practice

The micro level interactions and their analysis at the heart of this study provide important clues about what's needed to cultivate organizational change to set the stage for bridging the digital use divide, especially at schools serving vulnerable populations.

Important elements of effective PLCs. The first consideration for practice points to the power of a professional learning community in augmenting a group's ability to collaboratively learn in order to support student learning. The research on PLCs suggests that effective PLCs use teacher talk and collaborative work to honestly share existing practices and their effects, to explore new possibilities, and to try out new ways of teaching to see how the practices impact student learning (DuFour, 2007; Little, 2012; Stoll & Louis, 2007). Key to the teacher talk represented in this Tech PLC were interactions that leveraged shared resources to collaboratively come up with a new tool to support students' productive technology use that could also leverage classroom learning. Based on these findings, school administrators who make time and space for PLCs would benefit from considering the richness and depth of each group's shared resources such as access to outside professional development opportunities, aligned curricula, and supplementary materials.

Interestingly the two participants who consistently offered the most affirmations and invitations across all the meetings came from teacher preparation programs emphasizing

social emotional learning, mindful practices, and growth mindsets. It is unclear how much this educational background (compared with the teachers' natural dispositions) influenced their uses of affirmations and invitations with others. Another potential area of study might include examining the effects of professional development on interactional aspects of PLC collaboration. How might supporting members' mindful affirmations and invitations affect the group's engagement in honest discussions of classroom practices? Could setting PLC goals of transparency, exploration, and group agreed-upon actions affect outcomes? Examining how targeted guidance and support affects teachers' collaboration may support more effective PLC results.

Iterative processes support systemic change. Over time, effective PLCs and teacher learning communities can lead to systemic organizational change. Such change is a recursive process and needs time to gain alignment and momentum. To illustrate this idea, the interactions captured in this study were influenced by shared experiences, contexts and goals over several years leading up to the time of the tech PLC in this study. The tech PLC was not an experimental group, nor was it a stand alone PLC focused on bridging the digital divide. Rather it was a structure and vehicle that allowed teacher leaders designated time and space to struggle through aligning their views of how to try out, then support the rest of the staff in integrating new practices using technology. The group drew from a shared vision of school wide technology integration across the school day in ways that emphasize high-level student uses. Their shared frames of reference, constructed over time, informed their PLC goal and their collaboration towards that goal as a step towards the larger vision.

The tech PLC's innovative practices were needed in order to develop shared resources for the broader organization, and participants' collaboration was informed by having shared the ongoing experience of technology integration as more than a one-time project. Opportunities to attend workshops, try new practices, and build on their understandings had been a part of the school's focus for development over the previous three years. Tech PLC participants equated repeated opportunities for learning as an important equity issue for students. Similarly, recurring opportunities to learn, along with site-level support for application, helped these teacher leaders to develop and deepen their own meaningful practices too.

Importantly, the teacher leaders who volunteered to participate in this study included staff members who had taken advantage of regular opportunities to attend local technology-related conferences such as annual GAFE Summits. The combination of these regular opportunities and a regular review of the school's technology integration process may have allowed teacher leaders to begin aligning their own learning with the learning needs of their colleagues. The summer prior to the Tech PLC of this study, Mark and Sara targeted a workshop on digital presentations because it was a topic they believed that the school was ready to try out, but that they had felt ill-prepared to teach or support the previous spring.

The long-term, sustained organizational focus also contributed to the level of collaboration and trust among the participants, as well as between this group and the school's leadership. Sprinkled through the PLC meetings, particularly in the last one focused on closure and next steps, were signs of a two-way collaboration between the

principal and tech PLC group members that had built up over time. This push-pull, mutual influence allowed for joint decision making on important factors such as whether and how to provide the time and space for planning, when to adjust meeting dates based on the changing demands of the school's calendar, and what administrative expectations for technology use should be shared with the whole staff and supported school-wide.

Feedback structures can leverage system-wide efforts. Parkview School reached the district's goal of one-to-one devices a full year ahead of the district's schedule and had developed more widely spread, innovative uses of technology compared with other sites in the district, allowing it to launch its technology-focused program of choice during the year of this study. Before the formal technology PLC at the center of this study, informal, voluntary meetings had been convened by the principal to gather input on matters such as technology purchase priorities, staff needs for supporting technology integration, and how to best leverage the help of local, corporate volunteers from the tech industry.

Regular opportunities for staff input informed technology investments, led to staff-wide opportunities for professional development, sparked school and community recognition of teachers who worked together to attain Google Educator certification (leading to more staff members working towards it), resulted in the first release day for tech-steering committee planning, and inspired the tech PLC at the center of this study. Informal feedback structures had helped the school move its technology integration forward by informing important leadership decisions and allowing for needed adjustments in the midst of organizational change.

This study's findings about the important reciprocal influences among a school's different layers of interactions support a systems view of school change (Senge, 2012) and are consistent with research on technology integration that highlights the interdependence among important aspects of a site's technology context (Zhao et al., 2002; Wong et al., 2008). Along these lines, feedback loops and changes in a school's interconnections and purposes have the potential to most dramatically change the system itself (Meadows, 2008). Because such systems are "always evolving," they "need to have the capacity as communities to prioritize new thinking and new practice and to persist in supporting it" (Senge, 2012, p. 69). The interactions captured in this study and previous interactions that informed tech PLC participants' "shared contexts and experiences," point to the importance of making time and space for feedback loops between school leaders and practitioners at the forefront of change.

Technology and change in a Title 1 school. Tech PLC participants' candid observations about the differences between the tech PLC and grade level PLCs highlighted one aspect of how the standards movement may continue to inadvertently affect technology implementation in schools serving vulnerable student populations who struggle to meet academic proficiency cut scores. Hargreaves (2007) had warned that a narrower focus of PLC work driven by a "tunnel-vision focus on manipulating and improving test scores in literacy and mathematics by any quick fix available" (p. 189) would be more common in communities such as those served by a Title 1 school. Urgency and change initiatives are constant realities in schools serving the poor. Meanwhile pressures to meet proficiency levels on tests have also directly affected

technology implementation in ways that reinforce passive, traditional uses in lower socioeconomic schools (Harper & Milman, 2016; Wong et al., 2008). The demands of teaching, monitoring, and re-engaging students who need more support in schools serving vulnerable populations are significant, and there are no easy answers for how to meet the challenges, sustain success, and have resources left over to tackle technology integration beyond the basic skills required for online test taking.

Perhaps it is not surprising that tech PLC participants expressed feeling motivated and engaged by the work of designing and planning innovative student technology uses in their classrooms compared with grade level PLC work. While Parkview's grade level PLCs focused on progress monitoring and supporting students' growth towards proficiency, designing rubrics for mastery allowed teachers to take a break from seeing "that kid as a number." Teachers believed that the presentation rubrics held real potential to empower all students in mastering real world communication skills. Aiming for rigorous, relevant skills such as creating and delivering digital presentations may be important for sustaining the day-to-day efforts of teachers in Title 1 schools. Because public perceptions don't always match what's happening in such schools, building opportunities for teachers to hear their students' voices, and to see them shine in authentic ways, may provide vital opportunities for teachers to recognize their students' strengths. Such occasions may help to sustain engagement and support of students' needs.

Incidental learning. The success of productive collaboration seemed to deepen trust among those involved in the joint work of clarifying and supporting the school's vision. Despite this researcher's conscious efforts to be mindful about negotiating interactions

with the participants by taking on a least evaluative, least managing role, being present and privy to the collaboration, the challenges, and the camaraderie that came from meaningful work, collaboratively accomplished, had positive affects on the relationships among participants in the PLC, including between teachers and the researcher-principal. Potential implications from these episodes suggest that when a principal works on a task with teachers, greater appreciation for the task along with increased trust among participants result. The experience points to benefits of making time to participate in the ground-level work of organizational change. Leaders who are looking to facilitate a change process may consider the humanistic benefits of joining such efforts, including opportunities to build or repair trust through the disruption of change, especially when change can impact the community's sense of aptitude or agency. With the many demands on school administrators, prioritizing and safeguarding such time can prove challenging, but worth the effort.

Another unanticipated benefit of the researcher-principal's participation in the tech PLC was the repairing of a relationship with one of the participants. The process started with listening to audiotaped meetings for analysis and member-checking, as outlined in the methodology. Upon listening to the first meeting, the researcher-principal noted the lack of "crosstalk" that happened when she spoke compared with when participants spoke, signaling a potential effect of the inherent power dynamics. This led to the researcher-principal's decision to take a least evaluative, least managing role in future meetings. Her intention was to refrain from giving input unless asked. This decision seemed positively acknowledged at the member checking process built into the next

meeting. In listening to the first meeting several times, the researcher-principal also noted that she had interrupted the same teacher participant more than once at that first meeting, yet had not talked over any of the other participants. In addition, the researcher-principal noted her own change of tone and reflected on her feeling of anxiety when the teacher was elected by the group to be the tech PLC facilitator. The researcher-principal's awareness that her outward actions might have reflected real bias from previous interactions with the teacher led to extensive reflection, captured in the researcher's notebook. From there, she made the decision to consciously combat the bias by making efforts to engage with and listen to that teacher both in and out of the tech PLC. About a month later, after the third tech PLC meeting, when the audio recorder was turned off, the teacher surprised the researcher-principal with a "good luck" gift in front of the group. It was just before the principal and several tech PLC team members would be presenting the school's new tech-focused program at a district showcase. At the conclusion of this study, the researcher-principal privately shared with the teacher her own feelings that the process had helped to repair their relationship, to the teacher's acknowledgement and agreement.

Effects of making space for research and reflection. Building in structures and routines to reflect on what was happening in the tech PLC throughout the process seemed to contribute to the quality of the work, as well as to the tone and tenor of the collaboration. Originally incorporated to provide participants with regular opportunities to learn about the study's findings as they emerged and to give them a voice in correcting misrepresentations or misconceptions on the part of the researcher, these member checks

also brought unanticipated benefits. Sharing findings about the group's interactions based on the framework of effective PLCs brought these concepts and understandings to the group, potentially reinforcing them. In addition, by providing summaries of what was accomplished and the researcher's conjectures about how interactions supported the work, member checking reinforced the group's sense of productivity and mutual trust. At the member checking following the release day, the summary of what happened that day was met with an immediate comment of, "Pretty amazing!" by one of the participants. These debriefing periods prompted participants to reflect on the group's interactions and to share what they felt contributed to their collaborative efforts. This was not a common process and potentially contributed to the outcomes of post-PLC survey responses.

Much of what school leaders do on a day-to-day basis involves calendaring meetings, preparing for meetings, formal observations, informal classroom visits, aligning school budgets, spending school budgets, attending to questions and concerns from parents, staff members or district level higher ups, handling student discipline incidents and checking tasks off in between putting out fires or trying to avoid them.

This leaves precious little time for reflection, much less survey design and analysis, member checking, or consulting with a "critical friend." Without setting apart these times to meet, the researcher-principal might have missed the opportunity to explore the school's tech context data so comprehensively. Similarly, without an interested thought partner, the opportunity for interactional analysis may have slipped by. It was in conversations with the "critical friend" as a sounding board, that the seeds of the analysis were sewn.

The extra efforts put into survey design (and testing), response analysis, and summarizing meetings' accomplishments and interactions for member checking contributed to the quality of the tech PLC work, to the degree of pride that the participants felt about what they accomplished, and to the findings of this study. From a practitioner's perspective, the research process oftentimes feels painstakingly, sometimes wastefully, slow and exhaustive. Yet without taking the time to analyze this process at the level that this study did, it would have been easy for both researcher and principal to miss the forest for the trees in understanding important elements of the tech PLC. It would have been easy to focus only on the completion of the PLC task without developing understandings of how the school contexts and capacities contributed to the work or how the interactions among participants helped them to accomplish what they did. It would have been easy to miss the real significance of what was collaboratively accomplished.

Leadership applications. For district leadership, implications of this study involve recognizing key aspects of technology integration, organizational change, and teacher leadership. This study, and the context leading up to it, begins to illustrate the complexity involved in thoughtful technology integration that holds promise to avoid or even bridge the digital use divide. Because of its ever-changing nature, and because of the new focus on students' productive uses, the arena of educational technology has been relatively buffered from wholesale commercial takeover. Technology integration, along with other major shifts embedded in the common core standards, challenge teachers to design, implement, and adjust curriculum in ways unseen since more than a decade of No Child Left Behind slowly relegated most curricular design and lesson planning to textbook

companies. They now rush to catch up, and practitioners in the field must also begin again.

As teachers find their sea legs on this new wave of change, the particularly nimble design common-core aligned worksheets for Teachers Pay Teachers and Pinterest. Tech innovators present at conferences. Everyone else needs time and support. District leaders, especially in communities serving a diverse range of students, would do well to balance meaningful district-wide initiatives with the time and flexibility for individual schools' long-term plans for achieving them. The "endemic tension between figuring things out and getting things done" (Horn & Little, 2010, p.208) may be stronger in schools facing more intense accountability scrutiny and more challenging public perceptions. Setting and maintaining a vision for improvement is challenging in any public school context today, and even more so when short term, one-size-fits-all initiatives continually alter the course midstream. If nothing else, this case illustrates the time and long-term support needed for achieving meaningful incremental change. District leaders would do well to support school leaders in understanding local landscapes to inform and deepen their long-term vision for how to meet 21st century challenges.

In addition to planning for students' productive use of technology and supporting principals in developing and maintaining context-driven long-term planning, district leaders may also consider ways to support site-based, cross grade level PLCs for the purpose of building shared frames of reference and resources between teachers and the principal. This is no small undertaking, and because of the time demands of doing so,

principal buy in would be critical. If buy in were established, focused school level PLCs could support organizational change while also developing teacher leadership.

Recommendations for Future Research

The migration of standardized testing from paper and pencil to digital devices has brought a new wave of resources aimed at bringing technology into schools. In the district of the site at the center of this study, a three-year one-to-one technology initiative was launched with designated resources and wide latitude for site administrators to determine pathways and supports towards technology integration. As many schools and districts undertake this challenge with a new sense of urgency, studying site-level differences in how schools attend to technology integration may lead to important findings associating differences in technology deployment with the extent that the resulting integration helps to address the digital use divide.

Considering the context-related factors that can impact conditions for classroom technology integration, a technology PLC such as the one in this study is one avenue for sharing decision-making at the site level. Comparisons of technology integration among schools with varying degrees of shared decision-making might provide additional insights leading to guidelines about planning for technology investments—including both financial and human resources. Examining how sharing decision-making processes at varying levels in a school or district ultimately affect technology use could also help leaders to better understand the advantages and disadvantages of various pathways to technology investments for equitable integration.

It is also important to acknowledge and continue to explore potential unintended effects on student technology use that may come from differential pressures on Title 1 Schools related to testing and accountability. Shining a spotlight on Title 1 Schools focused on productive technology use to track and compare achievement results may help educational leaders see potential connections between closing the digital use divide and meeting proficiency goals.

This tech PLC's collaboration, with its voluntary cross-grade level participation and focus on technology use, differed from more pervasive grade level PLCs linked to monitoring and tracking student progress. With the wide range of collaboration and productivity associated with mandatory grade level PLCs, studying whether micro-level factors can be supported or taught could yield deeper knowledge about ways to support more effective teacher collaboration. Comparative or implementation studies focused on explicitly aligning resources, supporting productive teacher talk, or establishing some of the building blocks of effective teacher talk within learning communities might shed more light on how malleable these factors are and the effect that awareness and training could have on PLC outcomes.

Exploring connections between PLCs, school goals, and leadership decisions could lead to better understandings about potential pathways between PLCs and distributed site leadership. Exploring how context-factors might inform interactions between the school leadership and teacher learning could lead to new structures for feedback loops to inform systemic change. For example one might ask whether the degree to which PLCs take school context into consideration when allotting time, determining goals, and attending to

tasks needed facilitates a sense of success and connection with the rest of the organization. Does collaboration within groups that are aligned to key initiatives open up avenues for joint decision-making between teacher teams and the administration? Could strong meso-level alignment provide feedback loops about progress towards achieving organizational goals and the resources needed to support those goals? In addition to exploring potential feedback structures, understandings about the connections between teacher learning, school goals, and leadership practices could also help school leaders determine when it might pay for a principal to join teachers at the ground level of change.

Conclusion

With the many urgent calls for change and the continuous need for improvement facing schools, technology integration in schools and classrooms has proven elusive in part because it is not mandated, not tested, and not tracked by the public. There are no curriculum publishers or playbooks on how to get an organization to learn how to use technology effectively. And technology keeps changing. Thirty years of federal policies have led to online testing and new resources for bringing ICT into schools, but policies and resources have not made the task of integrating technology into teaching any simpler.

This descriptive case study of technology integration efforts by a technology PLC is chronicled and analyzed by an insider—a researcher-participant. It highlights some of the complexities involved in teaching with technology to bridge the digital divide. It examines human interactions in the context of change, down to the mundane details of which specific word to put in a rubric to be shared, and the factors that play into how a group negotiates such decisions. All big changes eventually come down to details and the

people who work through them in order to make something happen. In order for a PLC to help align some of those details and for its decisions to make a difference, many other small things need to line up as well. Yet at the heart of the work that was accomplished over the course of this study—from the small details to the big ideas—was the teacher participants’ will to make a difference for the children that they teach. They met, worked, and continued to learn together outside their classrooms and beyond their teaching days because they believed that their combined efforts, and the aligned practices of their school, could give their students “real” competencies worth something in the modern world.

The teachers recognized that the future is already here. The tech PLC and the context surrounding it provided them with an opportunity to take action.

References

- American Educational Research Association, American Psychological Association, National Council for Measurement in Education. (2014). *Standards for educational and psychological testing*. Washington, DC: American Educational Research Association.
- Anderson, G. L., & Jones, F. (2000). Knowledge generation in educational administration from the inside out: The promise and perils of site-based, administrator research. *Educational Administration Quarterly*, 36, 428-464.
- Ang, K. (2014, November). Concentrated Disadvantage in California Schools: The New Status Quo. *United States Common Sense*. Retrieved from <http://uscommonsense.org/research/concentrated-disadvantage/>
- Anyon, J. 1980. Social class and the hidden curriculum of work. *Journal of Education* 162(1), 67-92.
- Asselin, M., & Moayeri, M. (2011). The participatory classroom: Web 2.0 in the classroom. *Australian Journal of Language & Literacy*, 34(2), 45-45.
- Atkinson, T. S., & Swaggerty, E. A. (2011). Empowering fourth-grade researchers: reaping the rewards of Web 2.0 student-centered learning. *Language Arts*, 89(2), 99-112.
- Baker, D. (2014). *The schooled society: The educational transformation of global culture*. Stanford University Press.
- Barrett, B. D. (2009). No Child Left Behind and the assault on teachers' professional practices and identities. *Teaching and Teacher Education*, 25(8), 1018-1025.
- Bobbera, R. L. (2013). *Developing the principal's capacity to lead technology integration within the school: An action research study*
- Boschma, J., & Brownstein, R. (2016). The concentration of poverty in American schools. *The Atlantic*.
- Bolam, R., McMahon, A., Stoll, L., Thomas, S., Wallace, M., Greenwood, A., ... & Smith, M. (2005). Creating and sustaining effective professional learning communities. *Bristol: University of Bristol y Departament of Education and Skills*.
- Boschma, J., & Brownstein, R. (2016). The concentration of poverty in American schools. *The Atlantic*.

- Bowles, S. and Gintis, H. (1976). *Schooling in capitalist America: Educational reform and the contradictions of economic life*. New York: Basic Books, Inc. Chapters 1 and 3.
- Bruce, B. C., & Casey, L. (2012). The practice of inquiry: A pedagogical ‘Sweet spot’ for digital literacy? *Computers in the Schools*, 29(1), 191-206.
doi:10.1080/07380569.2012.657994
- Calderón, B. (2009). Towards an ecology of learning: Children meaning-making with digital technologies in out-of-school settings. *International Journal of Learning*, 16(9), 153-167.
- Charmaz, K. (2014). *Constructing grounded theory*. Thousand Oaks, CA: Sage.
- Chrispeels, J. H., Castillo, S., & Brown, J. (2000). School leadership teams: A process model of team development. *School Effectiveness and School Improvement*, 11(1), 20-56.
- Coffey, G. (2012). Literacy and technology: Integrating technology with small group, peer-led discussions of literature. *International Electronic Journal of Elementary Education*, 4(2), 395.
- Cook, K. (2015). Computers in the classroom. *Computers in the Classroom -- Research Starters Education*, 1-1.
- Consortium for School Networking. (2016). CoSN’s 2015 Annual E-rate and Infrastructure Survey.
- Coughlan, S. (September 15, 2015). Computers ‘do not improve’ pupil results says OECD. [Web log post].
- Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches*. Thousand Oaks, CA: Sage.
- Cuban, L. (1990) Reforming again, again, and again. *Educational Researcher*, 19(1), 3–13.
- Cuban, L. (2009). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.
- Cuban, L. (2013). Why so many structural changes in schools and so little reform in teaching practice?. *Journal of Educational Administration*, 51(2), 109-125.

- Culp, K. M., Honey, M., & Mandinach, E. (2005). A retrospective on twenty years of education technology policy. *Journal of Educational Computing Research*, 32(3), 279-307.
- Darling-Hammond, L. (2010). Performance Counts: Assessment Systems That Support High-Quality Learning. *Council of Chief State School Officers*.
- Dawson, K. (2012). Using action research projects to examine teacher technology integration practices. *Journal of Digital Learning in Teacher Education (International Society for Technology in Education)*, 28(3), 117-124.
- Deschenes, S., Cuban, L., & Tyack, D. (2001). Mismatch: Historical perspectives on schools and students who don't fit them. *Teachers College Record*, 103(4), 525-547.
- Dolan, J. E. (2016). Splicing the divide: A review of research on the evolving digital divide among K–12 students. *Journal of Research on Technology in Education*, 48(1), 16-37. doi:10.1080/15391523.2015.1103147
- Dooley, C. M., Lewis Ellison, T., Welch, M. M., Allen, M., & Bauer, D. (2016). Digital participatory pedagogy: Digital participation as a method for technology integration in curriculum. *Journal of Digital Learning in Teacher Education*, 32(2), 52-62.
- DuFour, R. (2004). Schools as learning communities. *Educational Leadership*, 61(8), 6-11.
- DuFour, R. (2007). Professional learning communities: A bandwagon, an idea worth considering, or our best hope for high levels of learning?. *Middle School Journal*, 39(1), 4-8.
- DuFour, R., & Mattos, M. (2013). How do principals really IMPROVE SCHOOLS? *Educational Leadership*, 70(7), 34-40.
- Dutt-doner, K., Allen, S. M., & Corcoran, D. (2005). Transforming student learning by preparing the next generation of teachers for type II technology integration. *Computers in the Schools*, 22(3-4), 63-75.
- Ensminger, D. C., & Surry, D. W., (2008). Relative ranking of conditions that facilitate innovation implementation in the USA. *Australasian Journal of Educational Technology*, 24(5), 611-626.
- File, T., & Ryan, C. (2014). Computer and Internet use in the United States: 2013. *American Community Survey Reports*. Report prepared for U.S. Census

- Bureau, U.S. Department of Commerce. Retrieved from <https://www.census.gov/content/dam/Census/library/publications/2014/acs/acs-28.pdf>
- Giles, C., & Hargreaves, A. (2006). The sustainability of innovative schools as learning organizations and professional learning communities during standardized reform. *Educational Administration Quarterly*, 42(1), 124-156.
- Glass, G. (2008). *Fertilizers, Pills, and Magnetic Strips: The Fate of Public Education in America*. Charlotte, NC: Information Age Publishing, Inc.
- Gray, L., Thomas, N., & Lewis, L. (2010). Teachers' use of educational technology in U.S. public schools: 2009 Retrieved from <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2010040>
- Greene, M. (1997). A Philosopher Looks at Qualitative Research. In Jaeger, R. (Ed.), *Complementary methods for research in education*, 2nd edition (pp. 189-210). Washington, DC: American Educational Research Association (AERA).
- Greenwood, D. J., & Levin, M. (2006). *Introduction to action research: Social research for social change*. SAGE publications.
- Grimes, D., & Warschauer, M. (2008). Learning with laptops: A multi-method case study. *Journal of Educational Computing Research*, 38(3), 305-332.
doi:10.2190/EC.38.3.d
- Groff, J., & Mouza, C. (2008). A framework for addressing challenges to classroom technology use. *AACE Journal*, 16(1), 21-46.
- Gronn, P. (2008). The future of distributed leadership. *Journal of Educational Administration*, 46(2), 141-158.
- Gundy, M. S., & Berger, M. J. (2016). Towards a model supporting educational change. *International Journal of Information and Education Technology*, 6(3), 232.
- Hagerman, M. S., & White, A. (2013). What's the best formula for enhancing online inquiry skills?[(PST) 2+(iC3)]. *Reading Today*, 20-21.
- Hall, G.E., & Hord, S. M. (2015). *Implementing change: Patterns, principles and potholes* (4th ed.). Upper Saddle River, NJ: Pearson
- Halverson, R. (2007). How leaders use artifacts to structure professional community in schools. In Stoll, L. & Seashore Louis, K. (Eds.), *Professional learning communities: Divergence, depth and dilemmas* (93-105). New York, NY: McGraw-

Hill

- Hargreaves, A. (2000). Mixed emotions: Teachers' perceptions of their interactions with students. *Teaching and teacher education*, 16(8), 811-826.
- Hargreaves, A. (2007). Sustainable professional learning communities. In Stoll, L. & Seashore Louis, K. (Eds.), *Professional Learning Communities: Divergence, Depth and Dilemmas* (pp.181-195). New York: McGrall-Hill.
- Harper, B., & Milman, N. B. (2016). One-to-one technology in K-12 classrooms: A review of the literature from 2004 through 2014. *Journal of Research on Technology in Education*, 48(2), 129-142. doi:10.1080/15391523.2016.1146564
- Harris, A. (2008). Distributed leadership: According to the evidence. *Journal of Educational Administration*, 46(2), 172-188.
- Hasselbring, T. S., & Tulbert, B. (1991). Improving education through technology. *Preventing School Failure*, 35(3), 33.
- Hayes Jacobs, H. (2014). *Leading the New Literacies*. Bloomington, IN: Solution Tree Press.
- Herr, K., & Anderson, G. L. (2015). *The action research dissertation: A guide for students and faculty*. Thousand Oaks, CA: Sage.
- Herro, D. (2015). Sustainable innovations: Bringing digital media and emerging technologies to the classroom. *Theory into Practice*, 54(2), 117-127.
- Hord, S. M., & Southwest Educational, D. L. (1997). *Professional learning communities: Communities of continuous inquiry and improvement*.
- Hord, S. (2007). What is a PLC. *Southwest Educational Development Laboratory Letter*, 19(1), 3-5.
- Horn, I. S., & Little, J. W. (2010). Attending to problems of practice: Routines and resources for professional learning in teachers' workplace interactions. *American Educational Research Journal*, 47(1), 181-217.
- International Society for Technology in Education (ISTE) (2007). *Profile for technology (ICT) literate students*.
- James, M. A., & Hull, G. A. (2007). *Geographies of hope: A study of urban landscapes, digital media, and children's representations of place*. Online Submission.

- Jennings, P. A., & Greenberg, M. T. (2009). The prosocial classroom: Teacher social and emotional competence in relation to student and classroom outcomes. *Review of Educational Research*, 79(1), 491-525.
- Jesson, R., McNaughton, S., & Wilson, A. (2015). Raising literacy levels using digital learning: A design-based approach in New Zealand. *Curriculum Journal*, 26(2), 198-223.
- Jones, A., & Issroff, K. (2005). Learning technologies: Affective and social issues in computer-supported collaborative learning. *Computers & Education*, 44(4), 395-408.
- Kay, K., & Greenhill, V. (2013). The leader's guide to 21st century education: 7 steps for schools and districts. Boston, MA: Pearson.
- Kreijns, K., Kirschner, P. A., & Jochems, W. (2003). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: A review of the research. *Computers in Human Behavior*, 19(3), 335. doi:10.1016/S0747-5632(02)00057-2
- Krumsvik, R. (2012). Action research and ICT implementation. *Research in Comparative and International Education*, 7(2), 209-225.
- Ladson-Billings, G. (2006). From the achievement gap to the education debt: Understanding achievement in US schools. *Educational Researcher*, 35(7), 3-12.
- Ladson-Billings, G. (2009). *The Dreamkeepers: Successful teachers of African American children*. John Wiley & Sons.
- Larson, L. C. (2009). Reader response meets new literacies: Empowering readers in online learning communities. *The Reading Teacher*, 62(8), 638-648.
- Lee, T. L. (2014). *Educational technology and equity: Students access to and use of computers in low-socioeconomic and middle-class socioeconomic schools*. (2014-99150-164).
- Leonard, L. J., & Leonard, P. E. (2006). Leadership for technology integration: Computing the reality. *Alberta Journal of Educational Research*, 52(4), 212.
- 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*, 16(2), 233.

- Lin, J. M., Wang, P., & Lin, I. (2012). Pedagogy * technology: A two-dimensional model for teachers' ICT integration. *British Journal of Educational Technology*, 43(1), 97-108.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry* (Vol. 75). Thousand Oaks, CA: Sage.
- Little, J. W. (2002). Locating learning in teachers' communities of practice: Opening up problems of analysis in records of everyday work. *Teaching and Teacher Education*, 18(8), 917-946.
- Little, J. W. (2012). Professional community and professional development in the learning-centered school. *Teacher Learning that Matters: International perspectives*, 22-46.
- Louis, K. S., & Marks, H. M. (1998). Does professional community affect the classroom? Teachers' work and student experiences in restructuring schools. *American Journal of Education*, 532-575.
- Luhby, T. (January 29, 2015). The growing poverty problem in America's schools. *CNN Money*. Retrieved on May 2, 2016 from: <http://money.cnn.com/2015/01/29/news/economy/poverty-schools/>
- Maker, J. L. (2012). *Examining the Relationship between Professional Learning Communities and K-12 Teachers' Implementation of Technology*. ProQuest LLC. 789 East Eisenhower Parkway, PO Box 1346, Ann Arbor, MI 48106.
- Macbeth, D. (2003). Hugh Mehan's *Learning Lessons* reconsidered: On the differences between the naturalistic and critical analysis of classroom discourse. *American Educational Research Journal*, 40(1), 239-280.
- Marzano, R. J., Waters, T., & McNulty, B. A. (2005). *School leadership that works: From research to results*. ASCD.
- Meadows, D. H., & Wright, D. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green publishing.
- Mehan, H. (1979). *Learning lessons*. Cambridge, MA: Harvard University Press.
- Mouza, C. (2008). Learning with laptops: Implementation and outcomes in an urban, under-privileged school. *Journal of Research on Technology in Education*, 40(4), 447-472.

- Moore, D. C. (2013). Bringing the world to school: Integrating news and media literacy in elementary classrooms. *Journal of Media Literacy Education*, 5(1), 5.
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teach-*
- Munby, H. (1995). Gazing in the Mirror: Asking Questions about Validity in Self-Study Research.
- Nagel, D. (April 8, 2014). One-third of US students use school-issued mobile devices. [Web log post]. Retrieved from: <https://thejournal.com/articles/2014/04/08/a-third-of-secondary-students-use-school-issued-mobile-devices.aspx>
- National Commission on Excellence in Education (1983). *A nation at risk: The imperative for educational reform*. Washington, DC: US Department of Education.
- Nelson, T., & Slavit, D. (2008). Supported teacher collaborative inquiry. *Teacher Education Quarterly*, 35(1), 99-116.
- Newberg, N. (1991). Bridging the Gap: An Organizational Inquiry into an Urban School System. In Schön, D. A. (Ed.), *The reflective turn: case studies in and on educational practice* (pp. 65-83). New York, NY: Teachers College Press.
- Pascoe, C. J. (2011). *Dude, you're a fag*. Berkeley: University of California Press.
- Paulhus, D. L., & Vazire, S. (2007). The self-report method. In Robins, R.W., & Krueger, R.F. (Eds.) *Handbook of research methods in personality psychology* (224-239). New York, NY: Guilford.
- Petko, D., Egger, N., Cantieni, A., & Wespi, B. (2015). Digital media adoption in schools: Bottom-up, top-down, complementary or optional?. *Computers & Education*, 84, 49-61.
- Pow, J. & Fu, J. (2012). Developing digital literacy through collaborative inquiry learning in the web 2.0 environment: An exploration of implementing strategy informing science. *Journal of Information Technology Education Research*, Volume 11, pp. 287-299.
- PuenteDura, R. (2014). Ruben PuenteDura on Applying the SAMR Model. [Video file]. Retrieved from <https://www.youtube.com/watch?v=W6j8soDYoaw>

- Raddaoui, A. (2012). Democratization of Knowledge and the Promise of Web 2.0: A Historical Perspective. *Proceedings Of The European Conference On E-Learning*, 435-441.
- Ravitch, D. (2016). *The death and life of the great American school system: How testing and choice are undermining education*. New York, NY: Basic Books.
- Robinson, V. M. J. (2008). Forging the links between distributed leadership and educational outcomes. *Journal of Educational Administration*, 46(2), 241-256.
- Robinson, V. & Lai, M. K. (2006). *Practitioner research for educators*. Thousand Oaks, CA: Corwin Press.
- Robinson, V. M. J., & Timperley, H. S. (2007). The leadership of the improvement of teaching and learning: Lessons from initiatives with positive outcomes for students. *Australian Journal of Education*, 51(3), 247-262.
- Russell, T., & Munby, H. (1997). Reframing: The role of experience in developing teachers' professional knowledge. In Schön, D. A. (Ed.), *The reflective turn: case studies in and on educational practice* (pp. 164-188). New York, NY: Teachers College Press.
- Schnellert, G., & Keengwe, J. (2012). Digital technology integration in American public schools. *International Journal of Information and Communication Technology Education (IJICTE)*, 8(3), 36-44.
- Schön, D. A. (Ed.) (1991). *The reflective turn: case studies in and on educational practice*. New York, NY: Teachers College Press.
- Scott, K. A., & White, M. A. (2013). COMPUGIRLS' standpoint: Culturally responsive computing and its effect on girls of color. *Urban Education*, 48(5), 657-681. doi:10.1177/0042085913491219
- Seale, C. (2004). *Social research methods: A reader*. Psychology Press.
- Selwyn, N. (2010). *Schools and schooling in the digital age: A critical analysis*. New York, NY: Routledge.
- Senge, P. M., Cambron-McCabe, N., Lucas, T., Smith, B., & Dutton, J. (2012). *Schools that learn (updated and revised): A fifth discipline fieldbook for educators, parents, and everyone who cares about education*. New York, NY: Crown Business.

- Servage, L. (2008). Critical and transformative practices in professional learning communities. *Teacher Education Quarterly*, 35(1), 63-77.
- Shin, D. (2014). *Web 2.0 tools and academic literacy development in a US urban school: A case study of a second-grade English language learner* doi:10.1080/09500782.2013.771653
- Shulman, L. (1997). Disciplines of inquiry in education: A new overview. In Jaeger, R. (Ed.), *Complementary methods for research in education*, 2nd edition (pp. 3-29). Washington, DC: American Educational Research Association (AERA).
- Solomon, D., Watson, M. S., Delucchi, K. L., Schaps, E., & Battistich, V. (1988). Enhancing children's prosocial behavior in the classroom. *American Educational Research Journal*, 25(4), 527-554.
- Solomon, G., & Schrum, L. (2007). *Web 2.0: New tools, new schools*. ISTE (International Society of Tech Education).
- Sorapure, M. (2010). Information Visualization, Web 2.0, and the Teaching of Writing. *Computers & Composition*, 27(1), 59-70. doi:10.1016/j.compcom.2009.12.003
- Spillane, J. P., Halverson, R., & Diamond, J. B. (1999). *Distributed leadership: Toward a theory of school leadership practice*. Evanston, IL: Institute for Policy Research, Northwestern University.
- Spillane, J. P., Halverson, R., & Diamond, J. B. (2001). Investigating school leadership practice: A distributed perspective. *Educational researcher*, 30(3), 23-28.
- Spillane, J. P., Harris, A., Jones, M., & Mertz, K. (2015). Opportunities and challenges for taking a distributed perspective: Novice school principals' emerging sense of their new position. *British Educational Research Journal*, 41(6), 1068-1085. doi:10.1002/berj.3166
- Spillane, J. P., & Healey, K. (2010). Conceptualizing school leadership and management from a distributed perspective: An exploration of some study operations and measures. *Elementary School Journal*, 111(2), 253-281.
- Spillane, J. P., Diamond, J. B., Burch, P., Hallett, T., Jita, L., & Zoltners, J. (2002). Managing in the middle: School leaders and the enactment of accountability policy. *Educational Policy*, 16(5), 731-762.

- Spring, J. (2014). *Globalization of education: An introduction*. New York, NY: Routledge.
- Stake, R. E. (1995). *The art of case study research*. Thousand Oaks, CA: Sage.
- Stake, R. (1997). Case Study Methods in Educational Research: Seeking Sweet Water. In Jaeger, R. (Ed.), *Complementary methods for research in education*, 2nd edition (pp. 401-422). Washington, DC: American Educational Research Association (AERA).
- Stake, R. E. (2010). *Qualitative research: Studying how things work*. New York, NY: Guilford Press.
- Staples, A., Pugach, M. C., & Himes, D. J. (2005). Rethinking the technology integration challenge: Cases from three urban elementary schools. *Journal of Research on Technology in Education*, 37(3), 285-311.
- Steiner-Adair, C. (2015). The big disconnect: Your student in class vs. your student online. *Independent School*, 74(2).
- Stoll, L., Bolam, R., McMahon, A., Wallace, M., & Thomas, S. (2006). Professional learning communities: A review of the literature. *Journal of educational change*, 7(4), 221-258.
- Stoll, L., & Louis, K. S. (2007). *Professional learning communities: Divergence, depth and dilemmas*. McGraw-Hill Education (UK).
- Straub, E. T. (2009). Understanding technology adoption: Theory and future directions for informal learning. *Review of educational research*, 79(2), 625-649.
- Strother, D. L. (2014). *Understanding the lived experiences of secondary teachers instructing in one-to-one computing classrooms*. (2014-99170-003).
- SSD (2014). LCAP for Public Hearing SSD 060514. CA: Santa Clara County Office of Education
- Tarling, I., & Ng'ambi, D. (2016). Teachers pedagogical change framework: A diagnostic tool for changing teachers' uses of emerging technologies. *British Journal of Educational Technology*, 47(3), 554-572. doi:10.1111/bjet.12454
- Theoharis, G. (2007). Social justice educational leaders and resistance: Toward a theory of social justice leadership. *Educational Administration Quarterly*, 43(2), 221-258.

- Tierney, W. G. (1998). Life history's history: Subjects foretold. *Qualitative Inquiry*, 4(1), 49-70.
- Trilling, B. & Fadel, C. (2009). *21st Century Skills: Learning for life in our times*. San Francisco, CA: Jossey-Bass.
- Turner, K. N., Hayes, N. V., & Way, K. (2013). Critical Multimodal Hip Hop Production: A Social Justice Approach to African American Language and Literacy Practices. *Equity & Excellence in Education*, 46(3), 342-354.
- U.S. Department of Education /Office of Educational Technology. (2010). *2010 National Education Technology Plan*. Retrieved from <https://www.ed.gov/sites/default/files/netp2010.pdf>
- U.S. Department of Education. Office of Education Technology. (2014). *Learning Technology Effectiveness*. Retrieved from <https://tech.ed.gov/wp-content/uploads/2014/11/Learning-Technology-Effectiveness-Brief.pdf>
- U.S. Department of Education /Office of Educational Technology. (2016). *2016 National Education Technology Plan*. Retrieved from <http://tech.ed.gov/netp/>
- Valenzuela, A. (1999). *Subtractive schooling*. Albany, NY: State University of New York Press.
- Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education*, 24(1), 80-91.
- Vickers, G. (1965/1995). *The art of judgment: A study of policy making*. Thousand Oaks, CA: Sage Publications, Inc.
- Wenger, E. (1998). Communities of practice: Learning as a social system. *Systems Thinker*, 9(5), 2-3.
- 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. doi:10.3102/00028312039001165
- Wolcott, H. F. (1997). Ethnographic research methods in education. In Jaeger, R. (Ed.), *Complementary methods for research in education*, 2nd edition (pp. 327-364). Washington, DC: American Educational Research Association (AERA).

- Wong, E. M., Li, S. S., Choi, T. H., & Lee, T. N. (2008). Insights into innovative classroom practices with ICT: Identifying the impetus for change. *Educational Technology & Society*, 11(1), 248-265.
- Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race ethnicity and education*, 8(1), 69-91.
- Zhao, Y., Pugh, K., Sheldon, S., & Byers (2002). Conditions for classroom technology innovations. *Teachers College Record*, 104(3), 482-515. doi:10.1111/1467-9620.00170

Appendix A. Study Overview and Participant Consent Form

TITLE OF STUDY

The Impact of Professional Learning Communities on the Digital Use Divide

NAME OF RESEARCHERS

Dr. Arnold Danzig, San Jose State University
Pamela Cheng, SJSU Graduate Student
Department of Educational Leadership

PURPOSE

You have been invited to participate in a research study investigating how professional learning communities can affect the digital use divide in classroom instruction. The purpose of this research is to investigate how a site specific Professional Learning Community addressing the Digital Use Divide impacts teacher beliefs and practices within the context of the school. The results of this study will be used to inform educational practices related to building capacity for equitable technology implementation.

DESCRIPTION OF PROCEDURES

If you agree to participate in this study, you have the opportunity to join a professional learning community (PLC) as a participant researcher. This PLC will include the following:

1. Participants will join a tech PLC, including three one-hour meetings and a 4-hour half-day release for collaborative planning. The meetings will follow a PLC cycle including: 1. A one hour after school meeting to decide the goal of the PLC and what data the group will collect to inform planning. 2. Data gathering in own classroom 3. A half-day (four hour) release time will be provided for data sharing and collaborative planning to address the Digital Use Divide 4. A second one hour after school to examine student work, and share insights/ next steps
2. Student work samples shared at PLC meetings will be copied and retained as a data source for the study until the conclusion of the study, when it will be destroyed.
3. A third and final one hour after school meeting will debrief PLC results and participants will take a 20-minute, 10-question individual survey about the PLC experience.
4. Participants may be asked to participate in a 40 minute face-to-face, tape-recorded interview in your classroom or a location of your choice within two weeks of the last PLC meeting.
5. Meetings and interviews will be recorded digitally on a device such as an ipad or iphone for selective transcription. Digital recordings will be deleted at the conclusion of the study.

RISKS: There are no known risks to participating in this study beyond those risks you would encounter participating in a Google Form.

POTENTIAL BENEFITS: There is no compensation for participating in this study. You will not directly benefit from participating in this study. Indirect benefits will include a half-day release time for collaborative planning and the promotion of our understanding of the impact of professional learning communities on technology integration in our classrooms.

COMPENSATION

If available, the only compensation that would be provided would be a gift card in the amount of no more than \$10.00.

PARTICIPANT RIGHTS

Your participation in this study is completely voluntary and you may refuse to participate. If you agree to participate, you have the right to stop at any time with no penalty. You also have the right to skip any survey question that you do not wish to answer.

No service of any kind, to which you are otherwise entitled, will be lost or jeopardized if you choose to not participate in the study.

CONFIDENTIALITY

Although the findings of this study may be published, no information that can identify you will be included.

CONTACT INFORMATION

Questions concerning this research may be addressed to the researcher, Pam Cheng (graduate student in the Department of Educational Leadership, San Jose State University (408) 859-0890).

Complaints about this research may be presented to Arnold Danzig, Ph.D., Director of the Educational Leadership Program at SJSU (408) 924-3722 (office).

For questions about research subjects' rights or to report research-related injuries contact Dr. Pamela Stacks (Associate Vice President, Office of Research, 408-924-2479).

PARTICIPANT SIGNATURE

Your signature indicates that you voluntarily agree to participate in this study, that the details of the study have been explained to you, that you have been given ample time to read this document, and that your questions have been satisfactorily answered. You will be provided a copy of this consent form for your records. You

may refuse to participate in the entire study or any part of the study. If you choose to participate in the study, you are free to withdraw at any time without any negative effect on your relations with San José State University or any other participating institutions or agencies.

Participant Name (printed)

Participant Signature

Date

INVESTIGATOR STATEMENT

I certify that the participant has been given adequate time to read and learn about the study and all of his/her questions have been answered. It is my opinion that the participant understands the purpose, risks, benefits, and the procedures that will be followed in this study and has voluntarily agreed to participate.

Signature of Person Obtaining Informed Consent

Date

Appendix B: Technology Context Survey

Technology Context Survey

The purpose of this survey is to gather information about the current context and uses of technology at our school. Results will be used to seek out or make decisions about supports our school provides for learning and integrating technology for teaching in impactful ways.

The Grade Level I teach _____

I. Context

1. In general, how supportive is your team in helping with integrating technology into lessons? (Please check all that apply.)

- ☐ We set explicit goals and are generally able to support each other to reach them
- ☐ We are open to integrating technology and could use help
- ☐ We could use more time to talk about it together
- ☐ Other: _____

2. What types of supports with integrating technology into your teaching have you accessed in the past 6 months?

Check all that apply

- ☐ online communities or resources
- ☐ outside workshops (e.g. Google Summit, SVCUE, etc)
- ☐ district support (e.g. instructional coach, workshops, colleagues at other sites)
- ☐ peer support (e.g. grade level team, other colleagues at the site)
- ☐ not sure—would like to know more about options

3. Who do you ask for help when you have instructional technology questions? Please check all that apply.

- ☐ IT support
- ☐ Grade level teammate
- ☐ Teacher tech lead
- ☐ Other: _____

4. In general, how responsive is the support. Please choose one response:

- ☐ within the same day
- ☐ within a few days
- ☐ a week or more

II. Teacher

5. Please rate your use of the following applications or uses of technology with students for learning

0: Unavailable/ Not aware/ Not Applicable

1: I know that there are people on campus who use this

2: I have considered or looked into what's needed for doing this

3: This is technology I intend to try this year

4: I have used this technology and intend to continue using it

- _____ Type to Learn
- _____ Educreations
- _____ Book Creator or Adobe Voice
- _____ Presentations or Slides
- _____ Email
- _____ video editing
- _____ Website design
- _____ Coding programs or apps
- _____ excel for data gathering and analysis

6. How does technology support your teaching? Check the top three that best describe what you do at least 1x a week.

- ☐ Technology allows me to bring visuals into the classroom more easily.
- ☐ I'm most comfortable teaching technology when I can model with the whole class.
- ☐ I am working on how to monitor and manage students' use of technology.
- ☐ I use technology to making learning more interactive.
- ☐ I use technology to facilitate feedback to students about their work.
- ☐ I feel comfortable facilitating tech use and trouble shooting when needed.
- ☐ I feel that technology is an integrated part of my classroom instruction across content areas.

III. Students

7. What is the range of your students' experience with the types of Internet-based digital devices in your classroom? (Please check all that apply.)

- ☐ I'm unsure of students' backgrounds or experiences with the tech
- ☐ Most seem unfamiliar with using the technology
- ☐ Most have had exposure, but operate them narrowly or only as consumers (games, videos)
- ☐ Most have had experience with using the devices we to create or communicate
- ☐ Many can lead and support other students and/or myself with navigating and trouble shooting the apps that we will be using in class.

8. How often do students use technology for the following purposes in your classroom? (Please check all uses that apply and frequency of use.)

- ☐ Skills practice using designated apps.
How often? _____ Several times a day _____ daily _____ weekly _____ once in a while
- ☐ Research
How often? _____ Several times a day _____ daily _____ weekly _____ once in a while
Do students have input in choosing topics?

- _____ Always _____ Sometimes _____ Usually not
- ☐ Projects involving creation of digital learning objects (presentation, e-book, video, interactive map, etc.) What type are you working on now? _____
- ☐ Tech support for others (students or teachers) Example: _____
-

9. In your experience, how responsible are students with technology? (Please check the one that best matches your experience or impression.)

- ☐ Students have difficulty staying on task or using technology responsibly
- ☐ Students respond appropriately when limited in their access and choices of use
- ☐ Students demonstrate good decision making with guidelines and support
- ☐ Students take an active role in identifying and problem solving issues with technology

10. The digital use divide is being addressed and closed in my classroom.

- ☐ I'm unsure what this question is asking.
- ☐ Strongly disagree
- ☐ Disagree
- ☐ Agree
- ☐ Strongly agree

Appendix C Post PLC Participant Survey

Post PLC Survey

Thank you for participating in our inaugural tech PLC. Your answers to the following questions will help me to better understand what your experience was like to determine guidance and support for future Tech PLCs.

Inclusion

4-strongly agree: 3-agree: 2-disagree: 1-strongly disagree

1. Our group was able to come up with good plans.
2. I felt included in collaborative work.
 - a. What contributed to this feeling?
3. I felt part of decision making in the PLC.
 - a. What were key decisions that the group made?

Interactions among members— norms, rituals, behaviors

4-strongly agree: 3-agree: 2-disagree: 1-strongly disagree

4. Our group was able to come up with good decisions/ solutions.
 - a. What actions in the PLC influenced group communication?

Inspires Learning/ Growth

5. This PLC led me to new teaching or new practices.
 - a. 4-strongly agree: 3-agree: 2-disagree: 1-strongly disagreeIf rated this question a 3 or 4, to go to question 6. If no, skip to question 8

6. One new practice was (write in):
7. My implementation of the practice was successful.

4-strongly agree: 3-agree: 2-disagree: 1-strongly disagree

 - a. What made me feel successful:

8. I felt this PLC impacted my students' learning

4-strongly agree: 3-agree: 2-disagree: 1-strongly disagree

In what way?

9. The PLC helped me to try new uses of technology

4-strongly agree: 3-agree: 2-disagree: 1-strongly disagree

Please explain:

Bridging to broader community

4-strongly agree: 3-agree: 2-disagree: 1-strongly disagree

10. Participating in this PLC influenced my feeling of connection to the school.
 - a. In what ways? (write in)
11. I feel better able to support others at our school as a result of participating in this PLC.
12. Would you be willing to participate in a follow up interview about your Technology PLC experience? (Please circle one.) Yes No

Appendix D Post PLC Teacher Interview Protocol

Interview # _____
Date _____/_____/_____

Script for interviewing participants

Thank you so much for your participation in the technology PLC. As has been shared at the start of this study, the research aims to understand how teachers integrating technology into teaching are affected by participation in a site-level professional learning community aimed at bridging the digital divide. This interview will take about 40 minutes and will include questions about your experience through the PLC process. The purpose is to help me to better understand what being in the PLC was like for you, and how you think it might have influenced your beliefs or practices. I have some guiding questions to get us started on reflecting together on your experiences of the PLC. I would like your permission to tape record this interview, so I may accurately document the information you give me. If at any time during the interview you want to stop, please let me know. The goal of these questions is to help our school to better understand how to work with technology with equitable use and access for our students.

Your participation in this interview is completely voluntary. If at any time you need to stop, take a break, or return a question, please let me know. Do you have any questions or concerns before we begin? Then with your permission we will begin the interview.

Overview and Intro—"life history" of teaching with technology, ways merged with this project	
1. What experiences have informed your thoughts and feelings about technology integration in schools?	
2. What led you to join this tech-focused PLC?	
Important aspects of the PLC in influencing practice...	
3. What was participating in this tech PLC like for you?	
4. Was there a moment when you felt the group's ability to share honestly and problem solve was tested? If so, could you describe the challenge and how the group dealt with it?	
5. What contributed to or took away from the group's inclusiveness?	

6. Did the work of this PLC group affect how you view your students? Did this change in your view of students affect your interactions with students or their use of technology in the classroom? (looking at pedagogy and digital use)	
Influence of PLC on the school context and the school context on tech integration	
7. The definitions of the digital use divide is the difference between technology integration that emphasizes students' ability & voice in producing digital content compared with limiting students' technology use as users. What is your sense of our school's strengths in our technology integration in light of the digital use divide?	
8. What do you think are our school's biggest challenges to addressing the digital use divide?	
9. Has this PLC influenced your view of your role in supporting tech integration in our school? How?	
10. How would you describe this PLC group's impact on addressing the digital use divide? On the achievement gap?	
Views on technology integration to address the digital divide	
11. Now that it's over, how would you describe the significance of this PLC on your technology integration?	
12. What do you hope will be the outcome of this PLC or this study?	

Appendix E. Observation protocol

Observation Protocol – PLC Meetings

Date:

Topic or purpose of meeting:

Framework Aspects	Reflective Notes
<i>Descriptive Notes: Physical setting, quotes, appearances, sketches, events, activities, etc.</i>	<i>Connections, interpretations, insights, ideas, theoretical seeds or linkages.</i>
Inclusion—distributed Leadership? <ul style="list-style-type: none"> • Rituals for inclusion • Actions that prompt participation among group members 	
Interactions—collaborative problem solving? New Practices? Bridging? <ul style="list-style-type: none"> • Types of feedback, if any, offered in group • References to conversations or activities/ interactions outside of PLC and how impacts interactions, trust in the PLC • Roles for participation—what are they, who takes them on? Why? 	
Reflective Practice—teaching for learning? <ul style="list-style-type: none"> • Inquiry—what questions come up? • How are they answered? Who answers? • What plans are made? • What is the follow through? Sharing/ evidence of follow through from plans to practice • Confidence levels of group members over time 	
<u>School climate related factors</u> <ul style="list-style-type: none"> • Human infrastructure supports such as teams, partnerships venues for accommodating new projects <u>Leadership related factors</u> <ul style="list-style-type: none"> • Human infrastructure: vision, policies, resources as related to tech integration to bridge digital divide <u>Network related factors</u> <ul style="list-style-type: none"> • Technological infrastructure: access to computers, ability to acquire necessary tools, freedom to control tech involved 	

Appendix F. Study Timeline

Proposed Timeline for PLC for Addressing Digital Use Divide Study

10/26 Staff Survey: Technology Context
Overview and invitation to PLC group

10/31 Critical Friend Meeting

11/8 First PLC to set goals, select facilitator

11/17 Critical Friend Meeting

11/21 Member Checking
Full day release for data share and planning

1/6 Critical Friend Meeting

1/11 Member Checking
Student samples, rubric adjustments

1/13 Critical Friend Meeting

1/25 Last Tech PLC Meeting
Post PLC Survey

2/17 Critical Friend Meeting

2/6 Post PLC interview #1
2/6 Post PLC interview #2
2/16 Post PLC interview #3
2/17 Critical Friend Meeting

3/14 Critical Friend Findings review
3/31 Member checking: read through draft of findings

Appendix G. Presentation Rubrics

3rd-5th Grades Presentation Rubric

Skills	5 Advanced	4 Proficient	3 Basic Proficient	2 Approaching	1 Below
Delivery (Nonverbal) <ul style="list-style-type: none"> Eye Contact Body Language Poise 	<p>Holds attention of entire audience with the use of direct eye contact, seldom looking at notes.</p> <p>Movements seem fluid and helps the audience visualize.</p> <p>Student displays relaxed, self-confident nature about self, with no mistakes</p>	<p>Consistent use of direct eye contact with audience, but still returns to notes.</p> <p>Student made movements or gestures that enhances articulation.</p> <p>Makes minor mistakes, but quickly recovers from them; displays little or no tension.</p>	<p>Displayed minimal eye contact with audience, while reading mostly from the notes.</p> <p>Attempted movements or gestures that enhance articulation.</p> <p>Displays mild tension; has trouble recovering from mistakes.</p>	<p>Holds some eye contact with audience but majority of report is read from notes.</p> <p>Very little movement or descriptive gestures.</p> <p>Displays some tension and nervousness; has trouble recovering from mistakes.</p>	<p>No eye contact with audience, as entire report is read from notes.</p> <p>No movement or descriptive gestures.</p> <p>Tension and nervousness is obvious; has trouble recovering from mistakes.</p>
Delivery (Verbal) <ul style="list-style-type: none"> Elocution Enthusiasm 	<p>Demonstrates a strong, positive interest about topic during entire presentation.</p> <p>Student uses a clear voice with inflection and correct, precise pronunciation of terms so that all audience members can hear.</p> <p>Student maintains the audience's interest.</p>	<p>Consistently shows interest about topic.</p> <p>Student's voice is clear with inflection. Student pronounces most words correctly. Most audience members can hear.</p>	<p>Shows inconsistent interest toward topic presented.</p> <p>Student's voice is uneven. Student incorrectly pronounces some terms. Audience members have some difficulty hearing presentation.</p>	<p>Shows little interest in topic presented.</p> <p>Student's voice is low with little or no inflection. Student incorrectly pronounces terms, and speaks too quietly for a majority of students to hear.</p>	<p>Shows absolutely no interest in topic presented.</p> <p>Student mumbles, incorrectly pronounces terms, and speaks too quietly with monotonous tone. Majority of students cannot hear.</p>
Content/Organization <ul style="list-style-type: none"> organizes ideas around major points of information follows a logical sequence includes supporting details uses clear and specific vocabulary provides a strong conclusion 	<p>Student demonstrates deep knowledge of topic by addressing all parts of the assignment in logical, interesting sequence, while answering all class questions with explanations and elaboration.</p> <p>Provides clear purpose for presentation and presents ample important examples, facts, and/or statistics using specific vocabulary to teach about the topic.</p> <p>Provides a strong sense of closure and summarizes main points of the topic that leaves the audience thinking.</p>	<p>Student demonstrates consistent knowledge of topic by addressing all parts of the assignment in a logical sequence and answers all questions, without elaboration.</p> <p>Provides clear presentation and presents examples, facts, and/or statistics using clear vocabulary to teach about the topic.</p> <p>Provides a sense of closure by explicitly ending the presentation with related reflection or insight.</p>	<p>Student demonstrates some knowledge of topic by addressing most parts of the assignment in a somewhat logical sequence and is able to answer only basic questions.</p> <p>Purpose for presentation is not clearly defined and uses minimal/weak examples, facts, and/or statistics using non-specific/incorrect vocabulary to teach about the topic.</p> <p>Simple closure with restating the introduction or main idea may seem abrupt.</p>	<p>Student is uncomfortable with information but shows a little bit of knowledge on the topic with little logical sequence and is able to answer most surface level questions.</p> <p>Purpose for presentation is unclear/not mentioned and has no relevant examples, facts, and/or statistics and is off topic.</p> <p>Attempts to end the presentation, but may seem unconnected to the topic.</p>	<p>Student does not have grasp of information; student cannot answer questions about topic. The presentation is not finished and the audience is unsure of the purpose.</p> <p>The presentation has no representation of the assigned task.</p> <p>Does not end the presentation-just stops talking.</p>
Digital Presentation Design	<p>Engaging, effective slides. Images are focused, edited and formatted to enrich and effectively deliver presentation with minimal text.</p>	<p>Slides contain focused images that are edited and formatted to deliver presentation with minimal text.</p>	<p>Slides contain images that are somewhat focused, edited, and formatted to deliver presentation with minimal text.</p>	<p>Slides contain images that are ineffectively focused, edited or formatted to deliver presentation with minimal text.</p>	<p>Slides contain images that are not focused, edited and formatted to deliver presentation with minimal text.</p>

Scope of Presentation Tech Skills By Grade

	5th Grade	4th Grade	3rd Grade	2nd Grade	1st and K
Technology Skills Progression (By Grade level)	<p>Aligns text, font style and size for theme or emphasis.</p> <p>Strategically includes and edit pictures, charts and graphics to illustrate key points.</p> <p>Insert songs, videos, or other media on slides for effect.</p> <p>Inserts effective transitions that support flow and focus of message (transitions from slide to slide, on-click transitions)</p>	<p>Chooses appropriate text, font style for theme.</p> <p>Can edit pictures, charts, and graphics to illustrate key points.</p> <p>Can insert videos on slides.</p> <p>Can insert transitions between slides.</p>	<p>Can modify the text style and font.</p> <p>Can insert pictures, charts, and graphics to illustrate key points.</p> <p>Introduce students to: transitions, videos, songs and other graphics.</p>	<p>Can produce and modify text style and font.</p> <p>With help as needed, can find insert pictures and graphics to illustrate key points.</p> <p>Expose students to: transitions, videos, songs and other graphics.</p>	<p>Basic iPad foundational skills. (on, off, proper handling, basic functions)</p> <p>Students are introduced to a variety of media.</p>

K-2 Grade Presentation Rubric

Skills	5 Advanced	4 Proficient	3 Basic Proficient	2 Approaching	1 Below
Delivery (Nonverbal) <ul style="list-style-type: none"> Eye Contact Body Language Poise 	<p>Direct eye contact, seldom looking at notes.</p> <p>Student displays relaxed, self-confident nature about self, with no mistakes</p>	<p>Consistent use of direct eye contact.</p> <p>Makes minor mistakes, but quickly recovers from them; displays little or no tension.</p>	<p>Displayed minimal eye contact with audience.</p> <p>Displays mild tension; has trouble recovering from mistakes.</p>	<p>Some eye contact with audience.</p> <p>Displays some tension and nervousness.</p>	<p>No eye contact with audience, as entire report is read from notes.</p> <p>Tension and nervousness is obvious.</p>
Delivery (Verbal) <ul style="list-style-type: none"> Elocution Enthusiasm 	<p>Student uses a clear voice with inflection and correct.</p>	<p>Student's voice is clear with inflection. Student pronounces most words correctly.</p>	<p>Student's voice is uneven. Student incorrectly pronounces some terms.</p>	<p>Student's voice is low with little or no inflection. Speaks too quietly for a majority of students to hear.</p>	<p>Student mumbles, and speaks too quietly with monotonous tone. Majority of students cannot hear.</p>
Presentation Design	<p>Interesting and engaging slides images and text features to enrich and effectively deliver message.</p> <p>Excellent visual layout.</p> <p>Graphs/tables used and clearly described/explained throughout presentation.</p> <p>Presentation has no misspellings or grammatical errors.</p>	<p>Appropriate selection of images and graphics. Clear text to support and effectively share information</p> <p>Good visual layout.</p> <p>Graphs/tables used described/explained clearly to support presentation.</p> <p>Presentation has no more than two misspellings and/or grammatical errors.</p>	<p>Some slides with supportive visuals, poor font size/selection or layout designs.</p> <p>Visual layout is disorganized.</p> <p>Graphics/tables used but unclear or ineffective</p> <p>Presentation has three misspellings and/or grammatical errors.</p>	<p>Many slide designs ineffective, too wordy, and lacks of variety. (all bullet points with no graphs and tables)</p> <p>Design layout disorganized and hard to follow.</p> <p>Unrelated graphs for presentation.</p> <p>Presentation has four or more spelling and/or grammatical errors.</p>	<p>Slides poorly constructed that they distract from the presentation. Images does not match or support topic.</p> <p>Layout design very unorganized and hard to follow.</p> <p>No tables and graphs</p> <p>Presentation has too many spelling/grammatical errors for understanding.</p>

Appendix H. Code book for tech PLC

Code System: Umbrella Codes, Sub-codes, and code counts across meetings

1 Affirmation Invitation	1332
1.1 Bid	74
1.2 Laugh	244
1.3 agreement	287
2 Shared Resources	387
2.1 Tech skills or experience	72
2.2 Shared Context/ Experiences	114
2.3 Shared Vision	73
2.4 Aligned Resources	77
2.5 Student centered pedagogy	51
3 Teacher Talk Building Blocks	674
3.1 Transparency/ Trust	142
3.2 Group Buy-in/ Action	169
3.3 Engaging/ Exploring	363

1 Affirmation Invitation

Includes lexical search and analysis of “yeah” then filtered for instances of agreement (vs. transitions or connectors between ideas spoken by the same person).

1.1 Bid

Specific questions or comments that bring other participants into the conversation.

1.2 Laugh

Lexical analysis of laugh or laughing in transcript as it represents affirmation, shared understandings, or purposeful humor/ engagement, sometimes to lighten the tone of the conversation.

1.3 agreement

Verbal signals of agreement.

2 Shared Resources

2.1 Tech skills or experience

Related to teacher tech skills—from experiences in the classroom or workshops attended

2.2 Shared Context/ Experiences

interactions reflecting shared understandings or experiences including:

- pedagogical trends
- school culture
- student backgrounds or needs
- shared students
- calendar or time demands
- needs of colleagues and staffs
- strengths of staff
- similarities and differences in practices within the context

2.3 Shared Vision

Interactions reflecting attempts to align vision and practices or desire to better align practices and expectations within the context of the site

2.4 Aligned Resources

Referring to aligned materials or talk centered around trying to agree on how to align materials to the use or perspective of multiple participants

2.5 Student centered pedagogy

Emphasizes student agency—choice, voice in the production of media: includes sharing of evaluation criteria with students, student to student support, leadership roles

3 Teacher Talk Building Blocks

3.1 Transparency/ Trust

Includes instances of transparency of practice, or openness to honest and authentic sharing of classroom teaching practices.

Illustration of trust between members: sharing of classroom practice, intentions, shortcomings.

This also includes questions or admissions of limits of knowledge or practice, particularly as it helps to define or address pedagogical problems, roles of participants, or clarity of purpose/ task at hand.

3.2 Group Buy-in/ Action

The acceptance of group initiatives or decisions by each of the participating members.

Codes include PLC interactions or segments of talk that illustrate group agreement about collective actions, intentions and next steps.

3.3 Engaging/ Exploring

The ability to engage and explore problems of practice in order to collaboratively problem solve. Characterized by questions or open exploration of different perspectives—how to do something, what is important, or interpretations/ valuation of some current practice under question, clarifying definitions in order to align vision and tools to match, trying to balance tools to the contexts, simplicity vs. detail, deciding what's most important to align across grades and how

Appendix I. Permission to Conduct Study in S School District

Learn today, lead tomorrow.

Benjamin Picard Ed.D., Superintendent

September 20, 2016

Pam Cheng, SJSU Doctoral Candidate
Arnold Danzig, PhD.
Director, EdD Leadership Program
One Washington Square Hall
San Jose, CA 95192-0124

RE: Support of Research Project – PLCs' Impact on Digital Use Divide

To Whom It May Concern:

Please accept this letter as documentation that I have reviewed Pam Cheng's plans to conduct research with teachers at the school site where she currently serves as the principal in order to investigate the impact of professional learning communities on addressing the digital use divide. Once she has received SJSU IRB approval, we would be happy to have her implement her research at Lakewood School.

If you have questions, please email me at michael.gallagher@sesd.org

Sincerely,

Michael Gallagher, Ed.D.
Deputy Superintendent, Human Resources

Appendix J. San Jose State University IRB Approval

Office of Research
Division of
Academic Affairs

San José State University
One Washington Square
San José, CA 95192-0025

TEL: 408-924-2272
sjsu.edu/research

To: Pamela Cheng

From: Pamela C. Stacks, Ph.D.
Associate Vice President
Office of Research

Date: October 11, 2016

The Human Subjects-Institutional Review Board has approved your request to use human subjects in the study entitled:

“Professional Learning Communities' Impact on the Digital Use Divide”

This approval is contingent upon the subjects participating in your research project being appropriately protected from risk. The approval includes continued monitoring of your research by the Board to assure that the subjects are being adequately and properly protected from such risks. If at any time a subject becomes injured or complains of injury, you must notify Dr. Pamela Stacks immediately. Injury includes but is not limited to bodily harm, psychological trauma, and release of potentially damaging personal information. This approval for the human subject's portion of your project is in effect for one year, and data collection beyond October 11, 2017 requires an extension request.

Please also be advised that all subjects need to be fully informed and aware that their participation in your research project is voluntary, and that he or she may withdraw from the project at any time. Further, a subject's participation, refusal to participate, or withdrawal will not affect any services that the subject is receiving or will receive at the institution in which the research is being conducted. If you have any questions, please contact me at (408) 924-2479.

Protocol # S16161

cc. Arnold Danzig 0064